THE SENSORY PROFILES OF INFANTS WHO RECEIVED DIFFERENT METHODS OF PREMATURE NEONATAL CARE

Shirley Berniece Tudor

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DECLARATION

I, Shirley Berniece Tudor, declare that this research report is my own work. It is being submitted for the degree of Master of Science in Occupational Therapy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this, or any other, University.

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SB Tudor

On the ________________ day of _______________________________, 2010.

This research study is dedicated to my husband, Nicholas Crawford Tudor, who supported and assisted me with this research report, and to my daughter Danielle Grace.

ABSTRACT

This study investigated the sensory processing of premature infants between 7-12 months of age at Chris Hani Baragwanath Hospital using the standardised Infant/Toddler Sensory Profile. The design of research that was primarily utilised in this study was quantitative, cross sectional, descriptive research. Results indicated that 50% of all the premature infants were found to be low threshold infants, and tended to be over responsive to auditory, visual and tactile sensory stimuli. The Sensory Profiles of infants who underwent different methods of neonatal care including kangaroo mother care (KMC), where mothers were involved in a fulltime twenty-four hour KMC programme, and those who received mainly conventional care (CC) were compared. The only score that differed significantly between infants receiving different types of care was tactile processing, with the CC infants having more typical tactile processing scores. These findings were contrary to other KMC research, which may have been affected by the reliability of using this measure with this study sample and the small sample size of infants who received CC.

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DEFINITION OF TERMS

APGAR score- The APGAR score is determined by evaluating the newborn baby on five simple criteria (Breathing effort, heart rate, muscle tone, reflexes and skin colour) on a scale from zero to two, then summing up the five values thus obtained. The resulting score ranges from zero to 10. It is done after birth and then followed up at 5 minutes after birth to see how the newborn is adapting to the new environment.[1]

Autonomic nervous system- "The autonomic nervous system regulates an individual's ability to adapt to environmental changes through modulation of sensory, motor, visceral and neuroendocrine functions by means of its parasympathetic and sympathetic branches. The branches function together to promote adaptation and self-regulation in response to internal and external environmental demands" (p443).[2]

Conventional care- Conventional care is the conventional method of air-heated incubators to provide the preterm infant with a stable, individualised environment with humidity and temperature regulation.[3,4,5]

Dyspraxia- A developmental condition presenting as clumsiness of movement resulting from difficulties in planning unfamiliar motor tasks.[6]

Homeostasis- This is a state of equilibrium or an affinity to reach equilibrium, which is critical for the regulation of physiological cycles such as sleep/wake and feeding. This can take place on a behavioural level where self-regulatory behaviour attempts to restore homeostasis.[7]

Kangaroo mother care- Involves the technique of placing preterm babies naked on their mother, or father's, chest in an upright position wearing only a nappy, allowing for skin-to-skin contact, as an alternative to conventional care. The head is turned so that the ear is above the parent's heart and frequent breastfeeding is encouraged.[8,9]

Neurological threshold- This refers to the amount of stimuli that is required for a neuron or neuron system to fire.[10]

Postural control- The process of regulating the position of the body in space for the purposes of stability and orientation.[6]

Prematurity- The World Health Organisation currently defines prematurity as a baby born before 37 weeks of gestation, counting from the first day of the last menstrual period.[11]

Self-regulation- This process involves the organisation of information both internally from the body and externally from the environment to achieve homeostasis. Infants need adequate self-regulation to self-console and maintain a calm or organised state needed for regularity of sleep and feeding rhythms.[7]

Sensory integration- "Ayres developed the theory of sensory integration to explicate potential relationships between neural processes of receiving, modulating and integrating sensory input and the resulting output: adaptive behaviour. The theory postulates that adequate processing and integration of sensory information is an important substrate for adaptive behaviour" (p143).[12] From a sensory integration perspective, learning occurs when a person receives accurate sensory information, is then able to process it and use this information to plan and organise their behaviour in daily life activities.[10]

Sensory modulation- The nervous system operates on the basis of excitation and inhibition. Excitation occurs when the neurons are activated or become responsive, and inhibition occurs when responses are repressed. Modulation is the brain's regulation and organisation of sensory input in a graded and adaptive manner to maintain balance by either facilitating or inhibiting these responses.[10,13]

Sensory modulation disorder- Sensory modulation disorder is defined by Miller and Lane (2000) as a difficulty in the ability to regulate one's response to sensory input in a graded manner, which disrupts the ability to achieve and maintain the best range of performance necessary to cope with environmental challenges.[12]

Sensory processing- Miller and Lane (2000) defined sensory processing as including "reception, modulation, integration and organisation of sensory stimuli, including behavioural responses to sensory input" (p103).[13] For the purposes of this study, sensory processing will be defined according to Dunn's (1997) conceptual model, including sensory registration, sensory modulation and habituation and sensitisation.[10]

Sensory processing dysfunction- Sensory processing dysfunction was previously referred to as sensory integrative dysfunction, and is proposed to presents itself in three ways. The proposed patterns include: sensory modulation disorder, sensory-based motor disorder, and lastly sensory discrimination disorder.[12]

Vagal tone- This is the effect produced on the heart when only the parasympathetic nerve fibres control the heart rate, resulting in inhibition of the heart rate. [14]

ABBREVIATIONS

APGAR- Appearance, Pulse, Grimace, Activity and Respiration

CC- Conventional Care/ Incubation

CNS- Central Nervous System

DD- Definite Difference

HIV- Human Immunodeficiency Virus

ICU- Intensive Care Unit

KMC- Kangaroo Mother Care

NICU- Neonatal Intensive Care Unit

PD- Probable Difference

RTHC- Road-To-Health Chart

SI- Sensory Integration

WHO- World Health Organisation

CHAPTER 1 - INTRODUCTION

1.1 INTRODUCTION TO THE STUDY

Sensory problems, along with other areas of developmental delay, have been reported in children who were born prematurely. According to Dunn (2002), when a child receives inaccurate sensory input, this creates difficulty in processing the information and as a result affects the behavioural output.[10] These concepts have developed from a sensory integration perspective, which proposes that a child learns when sensory information is accurately received, processed and then used to organise behaviour.[10]

Sensory processing also includes sensory modulation, which is the ability to regulate incoming sensory information by either facilitating or inhibiting responses to allow for an appropriate environmental interaction.[10] Poor sensory processing can be noted by observing a child's behaviour and performance and can present in many forms, such as over responsiveness or under responsiveness to incoming sensory information.[10,12]

Evidence from the literature shows that a child who has been born prematurely and has undergone extensive, sometimes invasive, neonatal care is considered to be a "high-risk" infant and may be predisposed to developmental, learning, emotional and sensory problems.[15,16] These infants frequently display behaviours that indicate sensory processing dysfunction, with poor modulation and regulation of behaviour, slower processing of sensory information and disorganised or avoidant exploratory behaviour.[16]

There is however currently little research available in the occupational therapy context on sensory processing in premature infants and whether different methods of neonatal care influence a premature infant's sensory processing.

The neonatal care of premature infants has undergone much change over the last few decades, due to the realisation of the need for developmentally supportive care and due to shortages of resources in developing countries. Kangaroo mother care (KMC) has now become an accepted method of care for premature infants in healthcare facilities where there has previously been a reliance on conventional incubator care for preterm infants.[17,18]

1.2 STATEMENT OF THE PROBLEM

Sensory integrative problems, along with other areas of developmental delay, have been reported in children who were born prematurely. According to Anzalone and Murray (2002), premature and other at-risk infants exhibit behaviours that are consistent with sensory processing problems, including: slow processing of sensory information, inability to regulate behaviour, disorganised or avoidant exploratory behaviour and mild motor problems.[16] Faure and Richardson (2008) state that premature infants are more sensitive to sensory stimuli than infants that are born full term; they also tend to become over stimulated quickly.[19] On analysis of sensory processing, Case-Smith, Butcher and Reed's (1998) study found that preterm infants demonstrated mild problems with sensory responsiveness, frequently displaying sensory-seeking behaviours and high activity levels as compared to full-term infants.[15] Preterm infants have also been found to have problems with self-regulation and have difficulty achieving and maintaining homeostasis.[8,20] Research clarifying the neurological basis of sensory processing dysfunction, and whether these underlying neurological factors may be further affected or influenced by a premature birth, is limited. There is currently no information available on the sensory processing difficulties in premature infants within South Africa and the reliability and validity of the Infant/Toddler Sensory Profile in the South African context is also unknown.

Local and international literature on whether a premature infant's sensory processing is further influenced by the method of neonatal care that they received is sparse. The difference in sensory processing between infants who underwent either KMC or conventional care (CC) in incubators in their preterm care has not been researched.

The method of neonatal management of premature infants at Chris Hani Baragwanath (CHB) Hospital includes in most cases a combination of KMC and CC. Conventional care is only practised in the high and medium care wards and not in the low care KMC ward. During their hospitalisation, premature infants in the high and medium care wards undergo mainly CC but short periods of the KMC practice is encouraged. In the KMC low care ward, where infants are referred after stabilisation in high and medium care wards, KMC is practiced for twenty-four hours a day and mothers are involved in a fulltime KMC programme. In current research, KMC has been conclusively shown to be the more beneficial option to conventional incubator care, in the neonatal management of stable preterm infants. It has been shown to provide a buffer against over stimulation and is said to support the regulation of arousal levels and stress reactivity.[21] Kangaroo mother care promotes energy conservation, which allows for more frequent calm-alert states where the infant is in a responsive and content state.[19] It has also been associated with increased weight gain in infants, improved breastfeeding rates, less infections, reduction in infant stress levels and early discharge from hospital.[3,4,8,22,23,24]

1.3 PURPOSE OF THE STUDY

This study therefore aimed to investigate infants born prematurely and how this would, if at all, influence their ability to process sensory information at a later stage of development. This was assessed using the standardised Infant/Toddler Sensory Profile focussing on ages 7-12 months (uncorrected). This Sensory Profile yields much information about the infant's modulation of sensory stimuli and processing of input received by each sense, as perceived by the caregiver.

Sensory processing has been shown to be influenced by arousal and stress levels[13], as well as autonomic stability[12], and it was felt that the Sensory Profiles of the premature infants who underwent longer periods of KMC might possibly display a difference in sensory processing to those who had not been admitted to the KMC low care ward. The study therefore also aimed to compare the sensory profiles of infants who had been admitted to the low care KMC ward, where KMC is practiced for twenty-four hours a day and mothers are involved in a fulltime KMC programme, with those who had not.

1.4 JUSTIFICATION FOR THE STUDY

The need for research in this field of neonatology is critical as the number of infants at risk for significant developmental dysfunction is currently increasing. This is due to medical science advances that are keeping younger, smaller and ill preterm infants alive.[16] According to Blackburn and Hack (1995) and Klein and Taylor (1995), the "cost" of these medical advances to a preterm infant's developing central nervous system (CNS) is not fully known.[16] Tallandini and Scalembra (2006), highlight that preterm births represent a major problem for healthcare systems and for the family unit. They underline the fact that premature births impact the infant-mother relationship and disrupt the harmony in this relationship that should develop into a secure mother-infant bonding process.[8] Sensory processing problems, along with other areas of developmental delay, have been reported and documented in children who were born prematurely.[15,16,25]

By further investigating how prematurity affects an infant's sensory processing, the role of the occupational therapist in early detection and intervention of sensory processing difficulties in premature babies could be further enhanced. There is currently a problem with access to resources in a hospital such as CHB, as not all infants who are diagnosed with sensory processing difficulties have access to this specialised care. Few occupational therapists working at the hospital are trained to treat sensory processing difficulties and are unable to assess and treat all premature infants presenting with problems of this nature.

It was hoped that through this study more evidence would be obtained to advocate that different methods of premature neonatal care do have a direct effect on an infant's sensory processing. Thus providing CHB Hospital, which has a high number of infants born daily and limited resources available, with valuable management data for the development of future neonatal care programmes.

1.5 AIM OF THE STUDY

The aim of the study was to profile the sensory processing abilities of infants born prematurely at CHB Hospital who received different methods of care, with particular focus on their modulation of sensory input.

OBJECTIVES

The main objective of this study was to:

1. Profile the sensory processing of infants born prematurely who received neonatal care at CHB Hospital, once they were between the ages of 7-12 months (uncorrected).

Secondary objectives were to:

1. Compare the Sensory Profiles of infants who had been admitted to the low care KMC ward, where KMC is practiced for twenty-four hours a day and mothers are involved in a fulltime KMC programme, with those who remained in the high and medium care wards with minimal exposure to KMC
2. Ascertain the validity and reliability of the Sensory Profile for the South African sample used in this study.

1.6 ASSUMPTIONS OF THE STUDY

The following assumptions were made in the study:

1. Infants admitted to the low care KMC ward, where KMC is practiced for twenty-four hours a day and mothers are involved in a fulltime KMC programme, were considered to have undergone substantially longer periods of KMC than infants admitted to the high and medium care wards (these infants were referred to as the KMC group)
2. Infants who were only admitted to the high and medium care wards, where CC in incubators is mainly used, were considered to have undergone more CC (these infants were referred to as the CC group)
3. Infants were assumed to be HIV negative if their status was not recorded in their outpatient file.

CHAPTER 2 - LITERATURE REVIEW

2.1 INTRODUCTION

In this literature review, an appraisal of the effects of prematurity and sensory integration theory, focusing on the development of this theory, its assumptions and neurological basis is presented. Recent sensory processing literature, specifically the component of modulation, will be explored in detail with special focus on Dunn's model of sensory processing, as the Infant/Toddler Sensory Profile is based on the premises of this model. Lastly, the different types of sensory processing dysfunction will be discussed, with emphasis on sensory modulation disorder and the research in relation to premature neonates. The different methods of neonatal care and the effects of a premature birth on development and sensory processing will also be considered.

2.2 THE EFFECTS OF PREMATURITY

The World Health Organisation (WHO) currently defines prematurity as a baby born before 37 weeks of gestation, counting from the first day of the last menstrual period.[11] Tallandini and Scalembra (2006) showed that there has been a greater focus on research in this field due to a considerable rise in preterm births over the last two decades, which represents a significant problem for our healthcare systems.[8] According to Williamson et al (2008), preterm births are now one of the leading causes of infant deaths and morbidity in the United States, and premature births account for 70% of neonatal deaths and up to half of the long-term neurological deficits seen.[26]

Forcada-Guex, Pierrehumbert, Borghini, Moessinger and Muller-Nix (2006) state that due to the increased survival rate of preterm infants, there is now a large concern for the development and future socio-emotional outcomes of these children.[27] They report that research has generally shown that preterm infants tend to have more cognitive, behavioural, socio-emotional and academic difficulties compared to children born at full term.[27] Kirchengast and

Hartmann (2009) report that it has been well documented that males are more likely to be born prematurely, show higher mortality and postnatal complications, and are more at risk for respiratory complications and infectious diseases than females. They state that premature boys are generally less stable than girls after birth.[28] In experimental literature, a number of sequelae to prematurity are commonly described: these infants are at risk for developmental, learning and emotional problems, and are considered to be "high-risk" infants.[16] With further research there is now a greater awareness of the impact that premature births have on the mother-infant relationship and the family as a whole.

According to Tallandini and Scalembra (2006), a premature birth "disrupts this harmony that should develop and interferes with the mother-infant bonding process"(p253).[8] The birth of a preterm infant results in considerable economic implications for families as well.[26] It has been suggested that the parents' ability to adjust to the premature birth influences the quality of these infant-parent relationships, which in turn impacts on the infant's long-term competencies and development.[27] Forcada-Guex et al (2006) discussed in their study of children born prematurely that mother-infant dyadic patterns of interaction can either positively or negatively influence the developmental and behavioural outcomes for these children.[27] According to Williamson et al (2008), research shows that a preterm birth is a multifactorial problem resulting from genetic, social and environmental factors, which probably interact to increase risk.[26]

Premature infants are described as not being ready to receive and respond to social stimuli and this results in disorganised behaviour, which is often hard for the mother to interpret.[8] Behaviour includes being less responsive, attentive, alert and active than infants that are full term and there are high rates of feeding difficulties.[27] Some studies have aimed to look at school-going age children born prematurely and reported a higher incidence of academic difficulties amongst them. The cognitive delays or deficits reported tended to be more prevalent in very preterm infants.[27] Salokorpi, Rautio, Kajantie and Von Wendt (2002) reported that with the reduction of mortality amongst extremely low birth weight infants, there has been a rise in major neurological disorders, and as many as half of these infants born have minor developmental problems, such as a motor or speech delay or attention deficit.[29]

Results of Rose, Feldman and Jankowski (2002) showed that preterm babies are considerably slower at processing information that is presented to them than full term infants. In their study, infants took about 20% more trials to reach criterion and about 30% more time to complete tasks of recognition of a familiar face than full-term infants and showed more immature attention patterns. This was examined further to show that risk factors such as respiratory distress, time on a ventilator or the requirement of supplemental oxygen, were linked to slower processing and more immature patterns of attention.[30]

Sensory problems, along with other areas of developmental delay, have been reported in children who were born prematurely. According to Anzalone and Murray (2002), premature infants and other at-risk infants exhibit behaviours that are consistent with sensory processing dysfunction, including: a poorly modulated state, slow processing of sensory information, disorganised or avoidant exploratory behaviour and mild motor problems.[16] They tend to become easily overaroused and do not have effective ways of self-regulating or calming themselves and tend to have prolonged autonomic effects when overstressed.[16] Faure and Richardson (2008) state that premature infants are more sensitive to sensory stimuli than infants that are born full term; they also tend to become over stimulated quickly.[19] In Case-Smith, Butcher and Reed's (1998) study, they found that preterm infants demonstrated mild problems with sensory responsiveness, frequently displaying sensory-seeking behaviours and high activity levels as compared to full-term infants.[15] Infants that are born prematurely tend to be deprived of normal touch/haptic experiences during the first few months of life. According to Weiss (2005), the neural mechanisms and pathways for touch perceptions are one of the first to develop in utero and are one of the most developed sensory systems available to them at birth. She feels that touch experiences may be particularly significant to premature infants and have a major influence on their psychosocial development.[31] Faure and Richardson (2008) highlight that touch has been shown to form the foundation for the development of perceptual skills, such as spatial awareness, and is vital for learning and emotional, physical and intellectual development.[19]

Caprio, Sklamberg, Wasserman and Hendricks-Munoz's (1998) study used the Test of Sensory Function in Infants (TSFI) to ascertain differences in sensory processing between preterm infants and full term infants. They found that preterm infants exhibited statistically significant differences in visual tactile integration and adaptive motor function when compared to full term infants. No significant differences in ocular motor control, reactivity to tactile deep pressure and reactivity to vestibular stimulation on this test were noted.[32] The findings of Santman Weiner, Long, DeGangi and Battaile's (1996) research showed that prematurely born infants or those with regulatory disorders scored lower than normal infants on the TSFI and their results differed slightly from the study performed by Caprio et al (1998). They found that at 7-9 months premature infants fell in the at-risk range for reactivity to tactile deep pressure, ocular motor control and reactivity to vestibular stimulation. At 10 -12 months all the subtests fell in the at-risk range for the preterm group except visual tactile integration.[25] They did however recommend further clinical studies to standardise the TSFI for the preterm infant.[32]

Janssens, Uvin, Van Impe, Laroche, Van Reempts and Deboutte (2009) found in their study that psychopathology was 4 to 5 times higher in preterm infants using the Diagnostic Classification zero to three. They used the Infant/Toddler Sensory Profile as one of the assessment instruments for Axis I and found that compared to full term infants the preterm infants had significantly more diagnoses on Axis I. They reported higher incidences of regulatory disorders, and difficulty processing sensory, physiological, attention, motor, cognitive and affective experiences amongst preterm infants.[33]

This is supported by several studies that have shown that premature infants have difficulty organising behaviour and display differences in autonomic, attention and self-regulatory systems compared to full term babies.[8] Problems with self-regulation have been shown to impact on sensorimotor skill and emotional development.[20] A premature birth is now considered to be a risk factor for a child's later development, with immaturity of the CNS compromising an infant's ability to regulate their behavioural responses and process incoming sensory information.[8] With an inefficient or immature nervous system, the infant's ability to maintain homeostasis, which is critical for the self-regulation of physiological cycles such as sleep/wake and feeding, is affected.[7] This inability to regulate behaviour and process incoming sensory information accurately is considered by some occupational therapists to be an underlying sensory integration or processing difficulty, which is discussed in further detail below.

2.3 SENSORY INTEGRATION

Bundy and Murray (2002) describe sensory integration (SI) as the neurological process that organises sensory input from one's own body and the environment, enabling the body to be used effectively within the environment. It encompasses the entire sequence of CNS events that occur from reception of stimuli to the display of an adaptive environmental interaction.[34] There is currently more research occurring in the field of SI, as researchers are seeking more fidelity in SI intervention and as a result scientific studies are being conducted to eliminate criticism and scepticism of the SI theory in medical practice.[35] A comprehensive overview of the SI theory follows below.

2.3.1 The theory of sensory integration

Sensory integration is a theory that was developed in the 1970's by Dr. A Jean Ayres to describe possible relationships between the neurological processes of receiving, modulating and integrating information received from the senses and the resulting output known as adaptive behaviour.[12] Her underlying premise to the theory is that adequate processing and integration of sensory information is primarily required for adaptive behaviour to occur. Schaaf and Miller (2005) stated that because Ayres' theory focuses on adaptive behaviour and functional skills, it is frequently utilised by occupational therapists.[12,36]

Ayres (1972) hypothesised that "learning is a function of the brain and learning disorders reflect some deviation in neural functions" (p143).[12] Her theory of SI proposed that a subgroup existed amongst individuals with learning disorders that displayed difficulty with processing and integration of sensory information and that this was having an impact on their behaviour and ability to learn.[12,34] She theorised that these learning and behavioural difficulties were due to problematic integration of sensory input and inability of higher cortical centres to modulate and regulate lower sub-cortical sensory-motor areas.[12,34]

Sensory integration theory covers two main areas: sensory modulation and sensory discrimination. In Ayres' view, discrimination of sensory input leads to perception, conceptualisation and then action.[37] She felt that the role of discriminative sensory processing was in the development of body scheme, controlled co-ordinated movement, bilateral co-ordination, visual perception and praxis.[37] The focus of this study is not on sensory discrimination but rather on sensory modulation, which will be investigated and discussed in more detail in the following sections.

There is currently some confusion surrounding terminology associated with SI. Researchers and practitioners often use the same terms but with different meanings or understanding.[36] To avoid confusion, the terms used in this research report will be clarified in this section.

Miller and Lane (2000) define *sensory processing* as including

> "reception, modulation, integration and organisation of sensory stimuli, including behavioural responses to sensory input" (p103).[13]

According to Mulligan (2002), sensory processing and SI represent theoretical frameworks for describing the same type of functional problems and behaviours observed in children, but sensory processing is a more "globally encompassing construct" than is SI.[13,36] For the purposes of this study, *sensory processing* will be defined according to Dunn's (1997) conceptual model, which discusses the interaction of a number of neurobiological factors, including sensory registration, sensory modulation and habituation and sensitisation.[10,13] There seems to have been a recent move away from discussing problems with SI as a sensory integrative dysfunction, to rather discussing them as a sensory processing dysfunction, and a scientific workgroup is currently revealing much information as they study the diverse aspects of atypical sensory processing.[12]

Sensory registration according to Lane (2002) is used to describe

> "the behaviour of noticing a sensory stimuli in the environment"…"the first step that occurs centrally, [where] incoming sensory information is recorded at multiple levels within the CNS so that it can affect ongoing neural activity" (p103).[13]

Registration is better described as *sensory detection or reception*, which is in keeping with neurophysiological literature.[13]

Modulation according to Dunn (2002), is

> "the brain's regulation of neural messages by facilitating or inhibiting responses"…"when intact, the nervous system responds to some stimuli while ignoring other stimuli, and the child generates an appropriate adaptive response to the situation" (p7).[10]

This includes neuromodulation, which takes place on a cellular level and within the CNS, and then modulation of behaviour that refers to "responses that match the demands and expectations of the environment" (p103).[13]

Lane (2002) describes *sensory integration* from a neurophysiological perspective as

> "the process of combining sensation between or within a sensory system", which is also referred to as *synthesis* (p103).[13]

In contrast, Ayres' (1979) definition of *sensory integration* reflected behaviour

> "the neurological process that organises sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment " (p103).[13]

According to Schaaf and Miller (2005), the theory of SI is based on principles obtained from various spheres such as: occupational therapy, neuroscience, developmental psychology and education. The main assumptions are that:

(1) sensorimotor development is an important substrate for learning,

(2) the way an individual interacts with their environment directly shapes the development of the brain,

(3) the nervous system is plastic and able to change,

(4) the brain functions as an integrated whole and

(5) purposeful sensory-motor activities play a role in mediating plasticity.[12]

According to Schaaf and Miller (2005), many of Ayres' principles on which the theory of SI is based are still held in high regard, though with research and new knowledge it has been demonstrated that the complexity and integration of the nervous system is more than what was believed at that time.[12] The SI theory has been criticised due to the inclusion of hierarchical concepts, though it has been emphasised that Ayres incorporated both holistic and hierarchical concepts into her theory. She made use of hierarchical concepts to make communication of what were difficult ideas at the time easier, and for intervention to be guided.[34] According to Bundy and Murray (2002), it is more appropriate to base theory on a holistic systems view of brain function and to view the nervous system as interactive with both cortical and sub-cortical structures contributing to SI.[34] This was confirmed by Davies and Gavin's (2007) study, which is discussed later in further detail.[36]

According to Schaaf and Miller (2005), efforts at screening for poor sensory modulation have been made easier by the Sensory Profile, the Infant/Toddler Sensory Profile, and the Adult/Adolescent Sensory Profile designed by Dunn.[12] These profiles reveal information related to sensory processing and reflect much information about sensory modulation and reactiveness.[10,34,37] It is therefore necessary to review sensory modulation theory and surrounding concepts to obtain the necessary background information before discussing Dunn's model of sensory processing.

2.3.2 Sensory modulation theory

The concept of sensory modulation has frequently been discussed in SI literature. Modulation of sensory information is key to our ability to engage in daily tasks. Modulation allows a person to respond to relevant input, to not respond to what is unimportant, and to do so in a manner that promotes adaptive behaviour.[13] According to Lane (2002),

> "filtering of sensations and attending to those that are relevant, maintaining an optimal level of arousal, and maintaining attention to task all require modulation" (p104).[13]

When there is a difficulty modulating, attention is repeatedly diverted to changes in the surrounding sensory environment. Within the CNS, modulation on a physiological level is reflected in neuronal activity that is either heightened or dampened in response to sensory input.[13] The nervous system operates on the basis of excitation and inhibition. Excitation occurs when the neurons are activated or become responsive, and inhibition occurs when responses are repressed. Modulation is the brain's regulation and organisation of sensory input in a graded and adaptive manner to maintain balance by either facilitating or inhibiting these responses.[10,13] Intact modulation results in a nervous system that adapts to incoming stimuli to allow a child to respond appropriately in a situation.[10]

Lane (2002), states that modulation of behaviour enables an individual to respond to relevant information, to not respond to irrelevant input, and to do so in a way that encourages adaptive environmental interactions.[12,13] The balancing of excitatory and inhibitory inputs within the CNS continues subconsciously.[10,13] This is usually unrefined but present at birth, e.g. a crying infant will find their hands or fingers to suck on to soothe and calm, which is already a modulated behavioural response or self-regulating behaviour. As the nervous system develops and matures, the ability to modulate one sensory system's activity, via input to another system, becomes refined.[13] Environmental inputs supplement this developmental process by giving understanding of what is an appropriate environmental interaction and how to generate it.[13] Modulation of behaviour tends to become personalised at some point in this developmental process. What sensory input works for one individual does not necessarily bring about the same response in another.[13]

Wilbarger and Stackhouse (2006) indicate that although the theory of SI relies on the core writings of Ayres, her descriptions of the modulation of sensory input were only the beginnings.[37] They report that the concepts supporting sensory modulation have evolved over the last three decades as a result of the development and new findings that have taken place in neuroscience.[37] With regards to modulation, Ayres discussed the balance of both inhibitory and excitatory influences on brain functioning and described modulation as the nervous systems process of self-organisation. Ayres highlighted the role of the vestibular system in a modulatory capacity of the other sensory systems. She introduced the concept of *tactile defensiveness*, as avoiding or negative reactions to tactile stimuli that is non-noxious, and developed the term *gravitational insecurity,* which will be discussed further under section 2.3.6.[37] She discussed the possibility of hypersensitivity to other sensory modalities and together with Tickle (1980), Ayres described failure to orient to stimuli as *inadequate registration* of incoming stimuli.[37]

In 1980, Knickerbocker expanded on Ayres' work and broadened tactile defensiveness to *sensory defensiveness* and placed it on a continuum with *sensory dormancy*, which she viewed as too much inhibition.[13] Dunn and Fisher (1983) then proposed a concept that became the central thinking about sensory modulation for the next decade, that tactile defensiveness and registration problems were on a single continuum at opposite ends.[37] Bundy, Fisher and Murray (1991) added *aversive responses* and *sensory defensiveness* to modulation disorders already described by Ayres.[34,37] Royeen (1989) then proposed a sensory registration continuum model where over orientation and failure to orient sensory stimuli were at opposing ends of a continuum, and together with Lane she later introduced a midrange and proposed that the continuum could be circular for some children.[13,37]

Koomar and Bundy (1991) described a sensory modulation disorder as an over response, under response or as a fluctuating response to sensory input. They also postulated that an individual could have problems with both the discrimination and modulation of sensation.[37] Kimball (1993) introduced the very important concept of arousal into sensory modulation theory and she proposed that individuals with sensory modulation difficulties present with more fluctuating arousal or reaction levels than is the norm and this results in problems with adaptive responses. Most importantly, she introduced the term *shut down*, which is the behaviour and protective response to sensory overload. She described that some children react to severe overload and over arousal by going into physiological shut down.[13,37] Parham and Mailloux (1996) supported the view that modulation disorders are on a continuum from registration difficulties to sensory defensiveness and they felt that a dysfunction in modulation was described by fluctuations or a tendency to fluctuate at one extreme or another.[37]

Dunn and her colleagues contributed one of the most empirical works, a proposed conceptual model of sensory processing (1997) and the development of the Sensory Profile (1999), which shaped sensory modulation thinking. Her Sensory Profile reveals some information related to sensory integration and reflects much information about sensory modulation and reactiveness.[10,34,37] She then went on to later develop the Adult/Adolescent and Infant/Toddler Sensory Profiles, of which the latter is discussed in further detail below. From clinical experience it was felt that sensory modulation should be viewed as multidimensional rather than on a continuum of under or over responsiveness to sensation.[13] In the recent years, Miller et al (1999) and McIntosh et al (1999) quantified the notion of sensory modulation, to show that sensory modulation problems are associated with physiological abnormalities, not just behavioural deficits, and this is explored in more detail under the neurological basis for sensory modulation.[13]

In 2001, Miller, Reisman, McIntosh and Simon presented a new Ecological Model of Sensory Modulation to describe both contextual factors and individual symptoms. The model presented four contextual external dimensions namely culture, environment, relationships and tasks, which impact or influence sensory modulation. They felt that in sensory integration these external factors were often overlooked, however referrals for therapy frequently arise from difficulty in environmental interactions.[38] They described culture as the social norms and expectations that surround an individual and the environment as the physical and sensory setting that an individual resides in. They discussed relationships as being the interactions and links that an individual has with others in their environment and tasks as the roles of the individual. For children this would include daily tasks, play, school, sleep and socialising.[38] The internal dimensions of their model were attention, emotion and sensation and are represented as rotational stacking rings, with each internal dimension being multidimensional.[38] Each external dimension interacts with each internal dimension to sustain or to challenge responses in a specific situation. The internal dimensions are circular and have areas of shading to delineate responsivity.[38] This model has particular relevance to the South African context, where individuals experience significant cultural, relational and environmental stressors that cannot be overlooked when investigating sensory modulation.

2.3.3 Dunn's model of sensory processing

Dunn's Sensory Profiles have made efforts at screening for poor sensory modulation easier according to Schaaf and Miller (2005). These tools are caregiver/parent/self-report questionnaires that describe responses to sensation during daily life activities.[12] Dunn's (1997) proposed conceptual model of sensory processing describes the relationship among a few neurobiological factors, including sensory registration, sensory modulation and habituation/sensitisation.[13] The Infant/Toddler Sensory Profile characterises behaviours and performance in relation to sensory processing, and yields significant information about sensory modulation and how it impacts on a child's performance of daily activities.[10]

Dunn hypothesised an interaction between neurological thresholds and behavioural responses, which is based on her model in Figure 2.1. She feels that the interaction of these two continua provide a way to explain how children process sensory information and assists with the planning of intervention.[10] Neurological threshold refers to the amount of stimuli required for a neuron or neuron system to fire. At one end of the continuum where thresholds are high, it takes high amounts of stimuli to meet the threshold and to cause firing of the neurons. On the other hand where thresholds are low, it takes very small amounts of stimuli to fire the neurons.[10] In her model Dunn introduced the two extreme poles of the neurological threshold continuum, namely: habituation and sensitisation (Figure 2.1). Habituation occurs when the nervous system recognises something as a familiar occurrence and sensitisation occurs when the nervous system recognises an incoming stimulus as potentially important requiring immediate attention.[7,10] Habituation plays an important role in sensory processing, regulation and sensitisation.[7]

The other component of Dunn's model deals with the behavioural response/self-regulation continuum. According to Dunn, this refers to the way people act in relation to their thresholds. At each end of the continuum a child reacts either passively or actively in relation to their threshold, working against their thresholds as a way to reach homeostasis, and can be considered as the child's self-regulation strategies (Figure 2.1).[10] Dunn then looks at constellations of performance between these two continua discussed above, developing the four quadrants: low registration, sensation seeking, sensory sensitive and sensation avoiding (Figure 2.1). Quadrant scores reflect the child's responsiveness to sensory experiences. Low registration shows a constellation of high neurological thresholds and a tendency to be passive in relation to these thresholds. Sensation seeking represents high neurological thresholds with a tendency to exhibit active behaviour in relation to these. Sensory sensitivity represents low neurological thresholds with a tendency to be passive in relation to these and sensation avoiding represents low neurological thresholds with a tendency to exhibit active behaviour in relation to these thresholds.[10]

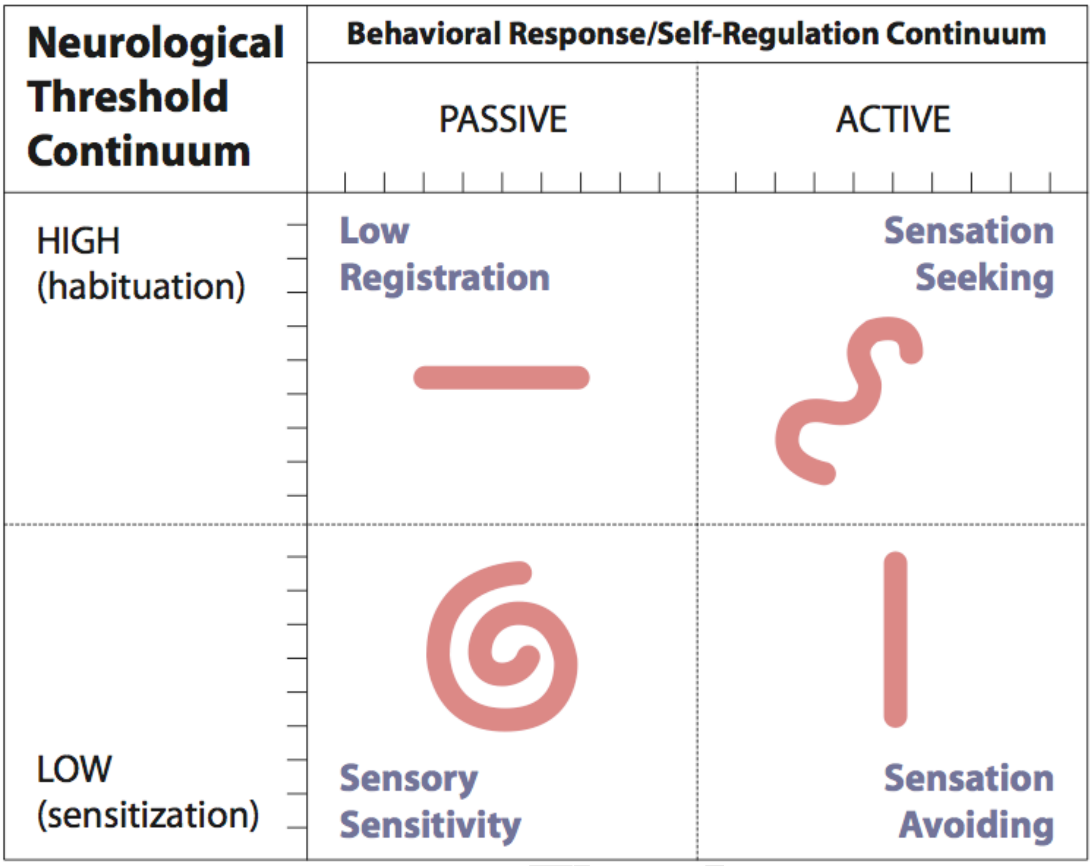

Figure 2.1 Relationships between behavioural response/self-regulation and neurological thresholds (Dunn, 1997, p8).[10]

2.3.4 Neurological basis of sensory modulation

Until recently, children with sensory modulation difficulties have been studied mostly from a behavioural point of view using psycho-educational tests and factor analysis to identify patterns or groupings of behavioural symptoms and categories of dysfunction.[2] Although valuable, these do not provide data regarding the underlying neural mechanisms of poor sensory processing. As a result, more research is currently being conducted to explore the physiological functioning in children with poor modulation to add to the research already linking sensory modulation deficits to autonomic nervous system dysfunction.[2] Therefore, our understanding of the mechanisms that underlie sensory modulation problems remains primarily hypothetical. It is proposed that sensory modulation involves regulatory processes at a number of levels. As discussed under Dunn's model of sensory processing, modulation can take place on a cellular level where neuronal excitability can either habituate or sensitise in response to incoming stimuli and affect thresholds.[10,13] Secondly, modulation is thought to involve neural systems such as the limbic, autonomic, vagal, reticular activating and cortical systems, discussed in detail below. And thirdly, sensory modulation involves behavioural or emotional responses to stimuli that may indicate underlying dysregulation as discussed above.[13]

According to Gilman and Newman (2003), the limbic system integrates our experience of the external world with the basic physiological processes that keep us alive and functioning.[39] The limbic circuits, at this basic level, maintain our internal environment to achieve homeostasis.[39] The limbic system plays an essential role in attaching emotional quality or meaning to sensation. It plays a part in learning and memory, specifically associative memory, and the linking of memories of past events with current sensory input.[13,39] Royeen and Lane (1991) hypothesised that modulation dysfunction could possibly have its roots in areas of the limbic system and hypothalamus.[13] They suggested that the involvement of the limbic system in sensory modulation

(1) provides an explanation for the emotional and behavioural difficulties that were associated with tactile and sensory defensiveness,

(2) explains the presence of defensiveness/dormancy across sensory systems, and

(3) allows for extreme changes or inconsistencies in response to stimuli displayed, either with regard to a single sensory system or across sensory systems (Royeen and Lane, 1991).[13]

Lane (2002) proposed that the avoidance behaviours associated with sensory modulation problems could be as a result of the limbic system attaching a negative emotional response to a particular sensory input.[13] Much of the research is based on animal studies, so extreme caution is recommended when generalising these findings to humans.

Schaaf, Miller, Seawell and O'Keef (2003) state that the autonomic nervous system regulates the ability to adapt to changes in the environment through the modulation of sensory, motor, visceral and neuroendocrine functions through its parasympathetic and sympathetic divisions.[2] These divisions function together to allow self-regulation and adaptation when met with internal and external environmental demands. The sympathetic nervous system modulates immediate phasic responses to events, like fight-or-flight response, and the parasympathetic nervous system modulates the visceral and neuroendocrine systems to encourage recovery from stress or a challenge and to sustain homeostasis and self-regulation.[2]

Research done by Miller and her colleagues (2001) looked to gain insight into the relationship between the autonomic nervous system functioning and behavioural responsiveness to sensations of children with poor sensory processing.[2,12] They examined ectodermal reactivity collected during a Sensory Challenge Protocol to determine sympathetic nervous system activity. They found that children who were behaviourally hyperresponsive to sensory input, showed elevated ectodermal responses and slow habituation to sensory stimuli.[2] Their results showed that children with poor sensory modulation who are behaviourally over responsive to sensory input had significant markers of sympathetic dysfunction as compared with typically developing children. Miller et al (1999) and McIntosh et al (1999) also found a correlation between the sympathetic overactivity and abnormal behavioural responses as measured by the Short Sensory Profile.[2] A child's anxiety and stress can amplify sensory modulation difficulties. The stress response is often measured by means of cortisol release, to quantify the physiological response to a stressor.[13]

Schaaf et al (2003) then focused their research on the parasympathetic nervous system.[2,12] The reviewed literature showed that high parasympathetic activity has been linked to homeostasis and the ability to cope adaptively with varying stimuli. Disorganised and decreased parasympathetic activity has been shown to be associated with problems in behavioural adaptation to changing stimuli and predicts stress, vulnerability, risk status or all these difficulties, in the clinical outcomes of infants.[2] It was also reported that premature infants with low parasympathetic activity tended to display poorer clinical long-term outcomes than those infants that had higher parasympathetic activity.[2]

In Schaaf et al's (2003) pilot research, it was shown that children with disturbances in sensory modulation had less effective parasympathetic functioning than typically developing children as shown by lower cardiac vagal tone and a lower heart period. They felt that their study laid the groundwork for further research to confirm their findings that abnormalities in parasympathetic activity are linked to sensory modulation difficulties, as adequate homeostasis provides a basis for the adaptive skills and flexibility of behaviour needed for successful engagement in daily activities.[2] They also supported Dunn's (2001) proposal that a child's physiological reactivity can affect the ability to process sensory information and in turn be an important determinant of behaviour.[2,10] According to Schaaf and Miller (2005) research therefore suggests that the functioning of the sympathetic and parasympathetic systems should be considered together when looking at the contribution that the autonomic nervous system makes to sensory modulation.[12]

Sensory integration literature has made links between sensory modulation and arousal and it has been proposed that the reticular formation is involved in the process of modulation. The reticular formation consists of a collection of nuclei that make up the central core of grey matter throughout the brainstem and functions prominently in the processing of pain, visceral function, posture, muscle tone and eye movements.[39,40] The nuclei of the reticular formation contribute to the regulation of behavioural arousal and sleep/wake cycles.[39,40] The reticular activating system and the limbic system work in conjunction to modulate the nervous systems response to sensations and emotions.[39]

Researchers have suggested relationships between performance, arousal and stimulus intensity and have shown that optimal arousal levels are linked to limbic and autonomic nervous system functions.[13] Kimball (1999) highlighted that moderate arousal produces an optimal adaptive interaction with the environment, but that over arousal/over stimulation leads to anxiety, behavioural disorganisation and possible negative responses.[13]

Davies and Gavin (2007) attempted the first study to examine the brain processing of children identified by occupational therapists as having a dysfunction of sensory processing and to compare these results to brain processing of children without disorders. They used the electroencephalogram measure of brain processing of auditory stimuli.[36] The children studied had been classified as having a sensory modulation disorder and were all evaluated with Dunn's Sensory Profile.[36] Their results supported the assumption of the SI theory that neural processing mechanisms are different in children with SI problems than their peers who are typically developing. They also showed that brain activity could also be used to correctly classify children with sensory processing problems and distinguish them from a group that is typically developing with 86% accuracy.[36]

Davies and Gavin's findings could be interpreted that children with sensory processing problems are deficient in their ability to filter out repeated or irrelevant stimuli and that they have difficulty selectively regulating the sensitivity of cortical responses to additional incoming sensory stimulation. This results in distraction, abnormal activity levels, disorganisation and anxiety, which are often behaviours observed in children with sensory modulation difficulties.[36] Davies and Gavin (2007) were only testing cortical activity in their research, which was shown to be different in the children with sensory modulation dysfunction compared to the control group. They felt that in future, SI theory may no longer want to describe this disorder as just sub-cortical but rather that sensory processing problems involve processing in both sub-cortical and cortical brain regions.[36]

There has recently been a shift to examine the possible role of neurotransmitters in sensory modulation difficulties. According to Lane (2002), alterations in CNS neurotransmitters, particularly serotonin (5HT), may be tied to defensiveness.[13] According to Cohen (1999), virtually all areas of the brain receive 5HT inputs suggesting that it is involved generally in many CNS functions and the expression of many behaviours and disorders. It must be noted that many of these studies are based on animal research and that these proposed links and conclusions should be interpreted with caution.[13]

It is important to review the potential links between these underlying neurological factors of sensory modulation, as discussed above, and how these may be affected or influenced by a premature birth.

2.3.5 Links between the neurological basis of sensory modulation and effects of prematurity

Research has indicated the role of the limbic system, autonomic nervous system, reticular formation, cortical systems, neurotransmitters and stress in sensory modulation, and it has shown that prematurity does place an infant at risk for future sensory processing problems, but there is a lack of research discussing the links between the proposed neurological basis of sensory modulation and problems of prematurity. This may be due to the fact that scientific evidence and testing for sensory processing dysfunction has only recently commenced to confirm these proposed theories and hypotheses. Studies have shown that preterm infants have differences in autonomic, motor, attention, self-regulatory systems and behavioural organisation measures when compared to full-term babies.[8]

Desantis, Coster, Bigsby and Lester (2004) state that with an inefficient or immature nervous system, the premature infant's ability to maintain homeostasis, which is critical for the self-regulation of physiological cycles, is affected.[7] Premature infants have difficulty regulating autonomic functioning and have been found to have an unstable heart rate, body temperature and breathing when separated from their mothers, therefore spending less time in quiet sleep.[24] It has been reported that premature infants with low parasympathetic activity tended to display poorer clinical long-term outcomes than those infants that had higher parasympathetic activity.[2] Vagal tone is a physiological marker of the infant's ability to regulate emotions, and in premature infants, vagal tone is associated with the degree of medical risk, with lower vagal tone indicating a less efficient parasympathetic nervous system.[24,25]

Bergman et al (2004) state that for most newborn infants their habitat is the "maternal milieu" in which a "nutrition programme", which is parasympathetically mediated, encourages optimal well being of the newborn infant and is ultimately expressed by an innate ability to breastfeed.[4] Premature infants that are separated from this "maternal milieu", display protest behaviours with despair being a superimposed parasympathetic response for survival which lowers heart rate and temperature.[4] Their protest behaviours also include sympathetically driven behaviours of crying and increased activity to return to the mother. Studies have provided evidence-based physiological rationale for separation stress in newborns, which is increased in premature births.[4]

Prematurity often involves early maternal separation, and it has been shown that maternal proximity plays a crucial role in the regulation of arousal levels and attention, which are foundational for further cognitive development to take place.[24] According to Feldman (2004), the early separation associated with prematurity is likely to lead to lifelong damage to systems of arousal regulation, attention and learning.[24] Premature infants often have difficulty regulating sleep-wake cycles, which have been shown to lay the foundation for the regulation of the arousal system. It has been shown that improved sleep-wake cycles lead to better arousal modulation, state organisation and emotional regulation.[24]With an inefficient or immature nervous system, the premature infant's ability to maintain homeostasis, which is critical for the self-regulation of physiological cycles such as sleep/wake and feeding, is affected.[7] Preterm infants have greater difficulty maintaining alertness and need more assistance to regain states of stability than full term infants.[41] They tend to become easily overaroused and do not have effective ways of self-regulating or calming themselves and tend to have prolonged autonomic effects when overstressed.[16]

Bergman (2003) states that when premature babies are separated from their mothers, as when incubated, stress hormones are reported to go dangerously high, lowering body temperature and heart rate to prolong survival.[23] Maternal proximity to an infant, which is often interrupted in premature births, has been shown to be critical in forming life-long capacities for stress management.[24] Premature infants often have increased crying and stress responses, which can further deplete energy and oxygen reserves, placing them at risk for brain injury and cardiac problems.[24] According to Williamson et al (2008), maternal exposure to stress causes the production of stress-related hormones that can play a role in uterine contractions and subsequent preterm delivery. Maternal stress can lead to an increase in foetal stress levels placing the unborn infant at risk.[26] Sources of stress in the neonatal intensive care unit (NICU) environment that preterm infants are exposed to include painful events, procedures, handling by medical staff and the physical environment. Light and sound in the NICU are environmental stressors that are known to cause behavioural and physiological disorganisation.[41] Anand (2000) highlighted that the undergoing of many painful procedures by preterm infants during their NICU stay influences their sensitivity to everyday pain. It was suggested that painful experiences in early human gestation influence the processing of subsequent pain, with increased painful preterm procedures resulting in dampened behavioural responses as a toddler, making it clear that the developing nervous system “remembers” the experiences of pain.[42]

On review of this information, it is clear that premature infants may have difficulty with one or many of the neurological processes that are proposed as underlying the processing of sensory input. Sensory modulation difficulties are assessed according to behavioural observations of a child's sensory processing and responsiveness to various sensory stimuli and are classified under sensory processing dysfunction, which is discussed in detail below.

2.3.6 Sensory processing dysfunction

Sensory processing dysfunction, previously referred to as sensory integrative dysfunction, is proposed to present itself in three ways. Schaaf and Miller (2005) report the following patterns: *sensory modulation disorder*, which is the over or under responding to sensory stimuli, *sensory-based motor disorder*, which is disorganised motor output as a result of poor processing of sensory information, and lastly *sensory discrimination disorder*, which includes postural control difficulties and/or dyspraxia.[12]

For the purposes of this research report, sensory-based motor disorder and sensory discrimination disorder will not be covered in more detail, as the focus of this study deals primarily with the field of sensory modulation. Sensory modulation disorder will be explored in more detail below. Ayres developed an assessment to evaluate SI problems called the Southern California Sensory Integration Tests, which covers sensory processing, sensory motor and perceptual motor skills.[12] This assessment tool was later revised and the Sensory Integration and Praxis Tests were developed to assess SI based dyspraxia and are still used frequently today by therapists in SI practice.[34] Dunn contributed to the pre-existing measures of sensory modulation by developing the Sensory Profiles, with the Infant/Toddler Sensory Profile explored in further detail below.[34]

2.3.6.1 Sensory modulation disorder

Miller and Lane (2000) define sensory modulation disorder as a difficulty in the ability to regulate one's response to sensory input in a graded manner, which disrupts the ability to achieve and maintain the best range of performance necessary to cope with environmental challenges.[12] Children and infants who present with poor sensory modulation, tend to over or under respond to normal environmental stimuli.[12] In infancy poor sensory processing is often related to regulatory problems like sleep difficulties, ineffective self-calming, high/low activity levels and slow attainment of motor milestones.[25] Deficits in sensory modulation can present in a number of different ways, depending on the sensory system or systems affected and whether the child over responds or under responds to incoming stimuli.

Commonly four types of modulation disorders have been discussed in the literature: under responsiveness, gravitational insecurity, sensory defensiveness (tactile, auditory and visual) and aversive responses to movement.[34] Children who are under responsive do not react to the intensity or frequency of sensory stimuli in the ordinary manner. According to Lane (2002), their responses seem dull and it takes a lot to get the behavioural systems activated.[13] Dunn used the term low registration to describe these under responsive children and this is discussed below.[10] Gravitational insecurity is often referred to as an irrational fear of heights and it is thought to result from poor processing of vestibular and proprioceptive input.[34] These children fear moving, or being in positions other than upright, or having their feet leaving the ground. Their fear is often out of proportion with the postural problems that a child may have.[34]

When looking at sensory defensiveness, tactile defensiveness has been the most frequently discussed dysfunction. Sensory defensiveness according to Bundy and Murray (2002), is the fight or flight reaction to sensory input that others may perceive as not harmful.[34] Children who have an aversive response or intolerance to movement appear to have poor processing of vestibular input and have autonomic nervous system reactions to movement that most individuals would consider to be non-noxious.[34] These children may have responses such as nausea, vomiting, flushing and dizziness in response to vestibular stimulation.[13] Dunn discussed these last three conditions as over responsiveness to sensory input, displayed particularly in the processing scores for the individual sensory systems implicated in each disorder. She stated that this over responsivity could be dealt with passively where a child is sensitive but does not behave to counteract this, or actively where they avoid situations that provide unwanted sensory stimuli.[10]

The current terminology that is most widely used to describe a child's pattern of sensory processing and modulation is based on Dunn's four quadrants as discussed previously, which describe a child's response to various daily sensory inputs. These quadrants are referred to as low registration, sensation seeking, sensory sensitive and sensation avoiding.[10] A child that presents with low registration is a child that has a high sensory threshold and it takes considerable sensory input for the child to respond. These children often present as unaware of their surroundings and disinterested, with a dull affect and low energy levels.[10] Dunn (2002) hypothesised that low registration children do not have sufficient neural activation to maintain performance over time and as a result miss significant cues from the environment to support ongoing responsivity.[10]

Children can behave in a manner that actively counteracts this high sensory threshold, by continually generating activity to receive more sensory input so that their thresholds can be met more often and are classified as sensation seeking.[10] They are driven to meet their thresholds by continually seeking sensory input across some or all of the sensory systems. They often present as noisy, fidgety, excitable, showing poor consideration for safety when playing and they may also chew on objects or hang on furniture or people.[10] Both the low registration and sensation seeking quadrants indicate children with high neurological thresholds, the former a passive response and the latter an active response to counteract a high neurological threshold.[10]

Dunn (2002) describes two other types of dysfunctions, namely sensory sensitive and sensation avoiding. A child with sensory sensitivity often presents as distractible and can be over active in certain instances. These children have difficulty sustaining focus on the task at hand, as they are often directing their attention to the latest stimulus that presents itself. They can become upset with their difficulty in progressing in tasks due to distractibility and are cautious in processing in activities where they may have missed out on information.[10] Dunn (2002) hypothesised that sensory sensitive children have neural systems that are sensitive and over reactive, which makes them aware of every stimulus, affecting the child's ability to habituate.[10] A sensory sensitive child often attempts to counteract this sensitivity by actively working to keep these thresholds from being met, which is then described as sensory avoidance or the child engages in disruptive behaviours. This occurs because meeting thresholds can be frightening or difficult for the child so they may have an emotional outburst or withdraw from a threatening situation.[10] They tend to be stubborn, controlling and resistant to change or new situations, creating rituals in their daily routine to avoid threatening situations.[10]

Both the sensory sensitive and sensation avoiding quadrants are children who have low neurological thresholds. A low threshold child may utilise both active and passive self-regulation strategies and they tend to be fussy children who are inconsistent in their responses and require much structure.[10] A child could have difficulty with the processing or modulation of one or more senses, as assessed on the Sensory Profile. For example a child could present with sensory sensitivity pertaining to only the oral/gustatory sense and therefore be a fussy eater and have difficulty coping with a variety of food tastes and textures.[10] In South Africa oral/gustatory sensitivity may go unnoticed in early childhood due to cultural and environmental factors. It has been noted that caregivers from lower socioeconomic groups in both rural and urban areas tend to give their infants limited foods like porridge and milk, or continue to breast feed even at 12 months resulting in a very limited range of tastes and textures being administrated orally.[43,44]

According to Ahn, Miller, Milberger and McIntosh (2004), functional problems associated with sensory processing dysfunction have frequently been discussed in literature and there is a proposed link between sensory processing problems and atypical behaviours.[45] The literature describes Parham and Mailloux's (2001) five functional impairments demonstrated by children with sensory processing dysfunction: poor social skills and limited participation in play, disturbances in self-confidence and esteem, difficulties in self-regulation and decreased adaptive responses, difficulties with daily life activities and poor sensory-motor skill development.[2,45] Children with sensory processing difficulties may also present with some of the following behaviours: distractibility, increased activity levels, anxiety, withdrawal and seeking or avoidance, which impacts on daily functioning.[2,45]

2.3.6.2 The assessment of sensory processing and modulation

According to Dunn (2002), the Infant/Toddler Sensory Profile (Appendix F1) characterises children's behaviours and performance in relation to sensory processing.[10] The profile covers two age groups: birth to six months and then 7-36 months, but for the purposes of this study, the profile for the older age group was used. It provides a standard method of measuring a child's sensory processing and modulation abilities and the degree to which these areas affect functional performance in the daily life of the child. It is a judgment-based caregiver questionnaire, with 48 items that describe a child's response to various sensory experiences.[10] The caregiver who is in contact with the child daily completes the questionnaire by reporting on the frequency with which these behaviours occur.

The therapist then scores the responses on the summary score sheet (Appendix F2) to detect certain patterns of performance indicating difficulties with sensory processing or performance.[10] The caregiver questionnaire has items divided into sensory systems, providing five sensory processing section scores (auditory, visual, tactile, vestibular and oral sensory processing), four quadrant scores (low registration, sensation seeking, sensory sensitive and sensation avoiding) and one combined low threshold quadrant score.[10] The quadrant scores show how the child responds to sensory experiences and are based on Dunn's model of Sensory Processing which has been discussed above. The child's quadrant scores are then plotted onto a grid to display whether his/her performance is typical or if there is a probable difference (PD) or definite difference (DD)- "*more than others*" or "*less than others*"- compared to other children in their age range.[10] Scores that fall out of the typical range could possibly indicate problems with sensory processing and in particular modulation, though further consult and follow-up is required to make a definite diagnosis.

The research on the Infant/Toddler Sensory Profile took place over four years starting in 1998. More than 1500 children participated in the study between birth and 36 months, some of these children had various disabilities and some premature infants were also included in the standardised sample.[10] Factor analysis was conducted to determine whether items clustered into meaningful groups.[10] The test was then classified into two sections, one covering birth-six months and the other 7-36 months, providing an estimate of the child's most likely performance when compared to peers.[10] Cut scores were developed to define the different categories of performance on the Sensory Profile and to indicate dysfunction in a particular area.[10] The test-retest correlation coefficient for the sensory processing section scores was 0.86, and 0.74 for the quadrants, indicating that caregiver rating is somewhat stable over time and is reliable to identify areas that require intervention.[10] On investigation of internal consistency, the alpha coefficients for the 7-36 months section of the Sensory Profile were found to range between 0.42 and 0.86.[10]

2.4 NEONATAL CARE FOR PREMATURE INFANTS

No research is currently available on how different types of premature neonatal care influence an infant's sensory processing. The neonatal care of preterm infants has undergone many changes over the past 10 years, largely due to the realisation of the need for developmentally supportive care. Worldwide, there are 20 million babies born each year with low birth weight and this represents approximately 15.5% of all births.[17,46] According to Blackwell and Cattaneo (2007), of those low birth weight babies, approximately 95.6% are born in developing, third-world countries where there is limited access to incubator care.[4,46] The WHO defines low birth weight as a baby born at less than 2500g and very low birth weight as a baby born at less than 1500g.[46] Of these infants, approximately one third die before they are stabilised or in the first 12 hours after birth. Low birth weight and very low birth weight babies need intensive neonatal care and nursing and this often takes place in facilities where resources are limited.[46] Many of these infants are preterm and have difficulty regulating their own body temperature so they are mostly placed in incubators.[17] Despite the current reliance on incubator care for premature infants, there is a large body of research that has now shown that the mother's chest, with skin-to-skin contact, is a much better and safer place for the premature baby.[23] Kangaroo mother care has now become accepted as an integral part of the continuum of standard neonatal care in healthcare facilities, especially for premature and low-birth weight infants.[18,47] In developing countries, where remote hospitals do not have access to incubators, KMC may be saving the lives of many infants.[18] However KMC is still often underutilised in low birth weight and very low birth weight babies in developed countries.[46]

When looking at conventional incubator care (CC), the use of air-heated incubators has been the standard method of caring for preterm infants at risk, providing a stable, individualised thermal environment.[3] According to Bergman, Linley and Fawcus (2004), traditional care or conventional care of prematurely born infants involves extended maternal-infant separation and incubator care. They highlight that recent research has shown this separation to have adverse effects on the infant. Often this "necessity" of separation of the mother and premature infant has been taken for granted in Western society.[4,5] The availability of incubators in Western, industrialised countries has made hypothermia uncommon, but in developing countries the scarcity of incubators means that hypothermia poses a significant threat to the survival of preterm infants.[3] According to Feldman (2004), CC often takes place in a NICU where the infant is bombarded with sensory stimuli, such as noise, light and exposure to pain and the infant's immature nervous systems have difficulty processing or warding off this stimulation.[24] Noise has been shown to interrupt sleep and can influence growth.[48] According to Graven (2000) long-term difficulties in auditory processing have been associated with infants that spend time in NICU.[48] Other than noise, concern has also been expressed about the exposure of immature infants to frequent light in the NICU through bright lights, phototherapy, heat lamps, procedure lights and even sunlight. This increased light intensity has been shown to cause an increase in heart and breathing rates in preterm infants in the NICU.[48] Fielder and Moseley (2000) state that premature infants have thin eyelids and are unable to protect themselves from room light until after 30 weeks when they can close their eyes tightly.[48] Another factor to consider is how exposure to continuous light affects circadian rhythms. It has been suggested that the preterm infant is responsive to light very early (25-28 weeks) and that cycling light in the NICU rather than patching eyes for total darkness has been linked with improved weight gain for these preterm infants.[48]

The biological research showing that newborns establish a habitat referred to as the "maternal milieu", with a parasympathetically mediated "nutrition programme" was highlighted by Bergman et al (2004). This encourages optimal well-being for development and attachment, expressed ultimately as an innate competency of infants to breastfeed.[4] In CC, the infant is separated from this "maternal milieu" and behaviours of "protest-despair" have been noted with sympathetically driven crying and protest activity to return to the mother.[4,5,23] There is evidence that an infant experiences separation stress leading to increased crying, increased cortisol levels, risk of intraventricular haemorrhage, delayed adaptation to extra-uterine life and attachment and behavioural disorders in childhood.[4,23] The effects of separation, as in CC, may be primarily responsible for making outcomes for premature newborns sub-optimal[4,23] and the premature infant caregiver should heed Kennel's warning: "Newborns should not be separated from their mothers" (p15).[5]

The practice of KMC was first developed by Doctors Rey and Martinez in Bogota, Columbia, where they worked in NICU's in overcrowded hospitals during the late 1970's.[21] There were not enough incubators for the amount of babies requiring support. They thought that skin-to-skin/chest-to-chest contact might be the alternative habitat to the incubator that the preterm infant required to regulate body temperature.[4,22] Kangaroo mother care was utilised initially in developing countries where incubators were in short supply. It is now also utilised in wealthier countries but usually as a complement to incubators or practiced only for a few hours at a time. The baby wears a nappy and is kept against the parents bare chest in an upright position, 24 hours a day with frequent breastfeeding.[9,17] Kangaroo mother care provides an alternative to incubator care, without separation from the mother.[4] Studies done have shown that the KMC practice is associated with increased weight gain in infants, improved breastfeeding rates, less infections and early discharge from hospital.[3,4,9,19,46] Blackwell and Cattaneo (2007) and Faure and Richardson (2008) report that research has shown that KMC babies spend more time in quiet sleep and less time crying as compared to infants that are not in contact with their mother.[19,46] Walker and Menahem (1994) report that literature on cross cultural infant rearing indicates that infants who are carried in close contact with the mother, usually on the back, display reduced fussiness and crying with longer periods of alert arousal.[49] In a Canadian study it was found that babies who were carried for four hours a day from four months, providing contact with the mother, cried and fussed 43% less than control babies.[50]

It is now widely accepted that KMC reduces the stress levels of the infant, encourages greater infant-parent bonding and influences family life positively, reducing the negative effects resulting from separation of the infant and caregiver.[3,22] Early initiation of KMC is a key feature.[21] Kangaroo mother care of preterm infants has been shown in a number of studies to improve or maintain cardio-respiratory stability, oxygen and energy expenditure, confidence and psychological stability of the mother and preterm infant behaviour development.[8,51] It provides a milieu that supports autonomic stability and encourages improvement in basic physiologic functions.[4]

According to Weiss (2005), research suggests that a preterm infant's exposure to stimulating, frequent and supplemental touch, in the first few months, may improve the infant's neuropsychological outcomes and both mental and psychomotor abilities. She also found that affective touch from a caregiver involving pleasurable, comforting sensations, as in the KMC practice, is associated with less behavioural and emotional problems resulting in greater security of attachment with the primary caregiver.[31] On the other hand Lynam (2003) states that touch in the NICU, where CC often takes place, is usually related to medical care rather than social nurturing.[48] Kangaroo mother care has been shown to provide a buffer against over stimulation and is said to support the regulation of arousal levels and stress reactivity.[21] Faure and Richardson (2008) state that KMC promotes energy conservation, which allows for more frequent calm-alert states where the infant is in a responsive and content state.[19] Most trial studies for KMC have focused on medically stable infants and therefore more research needs to be conducted on very low and extremely low birth weight babies. However, it has been shown that if KMC is commenced early, before stabilisation, the KMC process allows for earlier stabilisation of the infant.[46]

2.5 CONCLUSION

In conclusion, from the review of literature and current research it has been shown that premature infants are at risk for future sensory processing and developmental difficulties as a result of their preterm birth. From the review of SI literature, it was noted that there seems to have been a move towards using the term sensory processing, to include the reception, modulation, integration and organisation of sensory input and the resultant behavioural response, rather than sensory integration. On analysis of the proposed neurological basis of sensory modulation, a component of sensory processing, there seem to be possible links to neurophysiological difficulties that preterm infants experience, placing them at risk for sensory modulation difficulties. Sensory processing dysfunction was discussed with specific focus on sensory modulation disorder, as this was primarily evaluated in the premature infants participating in this research study with the use of the Infant/Toddler Sensory Profile.

Premature births have been shown to be increasing and there is much need for economical methods of care, which are developmentally supportive, for these infants at risk. Further research now indicates that the use of KMC in neonatal care results in better outcomes for both the premature infant and the mother when compared to CC, though there has been limited research conducted on extremely low birth weight infants. No research to date has reported a difference in sensory processing with different methods of neonatal care options.

CHAPTER 3 - RESEARCH METHODOLOGY

3.1 RESEARCH DESIGN

The design of research that was primarily utilised in this study was quantitative, cross sectional, descriptive research. In this descriptive study a group of premature infants who had received different methods of neonatal care was presented. The premature infants were identified retrospectively at the Neonatal and KMC Follow-Up Clinics at CHB Hospital. The components that were described were: (1) the sensory processing of infants born prematurely who received neonatal care at CHB Hospital, once they were between the ages of 7-12 months (uncorrected) and (2) the validity and reliability of the Sensory Profile for the South African sample population.

A comparative quantitative, cross sectional, non-experimental research design was used for the secondary objective of comparing the Sensory Profiles of the premature infants who had been admitted to the low care KMC ward, where KMC is practiced for twenty-four hours a day and mothers are involved in a fulltime KMC programme, with those who remained in high and medium care with minimal exposure to KMC at CHB Hospital.

3.2 POPULATION AND SAMPLE SELECTION

The population identified to be studied was from the Soweto region of Gauteng, South Africa and consisted of infants and caregivers attending the Neonatal and KMC Follow-Up Clinics at CHB Hospital. The sample for this descriptive study included premature infants who were between 7-12 months of age that had been admitted to the high and medium care wards, undergoing mainly CC, as well as those infants that had also been admitted to the low care KMC ward, where KMC is practiced for twenty-four hours a day, during their neonatal care.

At CHB Hospital either CC, or a combination of KMC and CC, is used in the neonatal management of preterm infants. In general, all mothers of infants weighing less than 2500g are encouraged to practice KMC as soon as the infant is stable, though this is not monitored rigorously in the high and medium care wards. The CHB Hospital's neonatal unit is divided into three areas:
(1) high care, which includes NICU and transitional intensive care unit (TICU),
(2) medium care in the maternity wards and
(3) a low care KMC ward.
Most commonly the infant is first stabilised in an incubator in high or medium care, before being sent to the low care KMC ward. The length of CC varies from infant to infant and was documented as being as short as one day in some subjects that were then admitted to the low care KMC ward. It must be noted that not all premature infants born at CHB Hospital are admitted to the low care KMC ward.[52]

In high care if an infant weighs less than 2000g, has been in NICU for longer than a week and is stable, a mother is encouraged to practice KMC intermittently with CC for no longer than two hours, twice or thrice daily. When infants from NICU are stable, they are transferred to TICU, though some infants are also admitted to TICU directly after birth. For all mothers of infants weighing below 2000g in TICU, KMC is prescribed intermittently with CC for a period of two to 12 hours per day. In the medium care maternity wards, mothers are encouraged to practice KMC intermittently with CC on all stable infants weighing below 2000g for six to 12 hours per day. It must be noted that this is the neonatal unit's policy but the caregivers in the study reported that they rarely performed KMC in the high and medium care wards and that this was not monitored rigorously. All infants admitted to high and medium care wards are regularly monitored until 12 months (corrected age) at the Neonatal Follow-Up Clinic.[52]

Stable infants are accepted into the low care KMC ward either from the medium care wards or from TICU, if there is bed space available. The infant needs to weigh at least 1100g and must not require oxygen or ventilation. In this ward, exclusive KMC is practiced for twenty-four hours a day and mothers are involved in a fulltime KMC programme that includes health education and counselling. In addition, demonstrations of infant feeding, washing and massage are included. Infants are discharged from the KMC ward when they reach a weight of 1600-1700g and have no other major health complications or feeding problems. All infants who were admitted to the low care KMC ward are regularly monitored until 12 months (corrected age) at the KMC Follow-Up Clinic.[52]

All infants that undergo CC in high and medium care are exposed to a developmentally supportive care programme at CHB Hospital, which was developed by their multi-disciplinary team. The programme looks at the handling and positioning of infants at risk to encourage normal development. Mothers are encouraged to place infants in a flexed position, sleeping them on their sides with a rolled blanket/towel around them for containment. This facilitates the infant with bringing hands to mouth for soothing and self-regulation. The use of the supine position for long periods is discouraged, as the child is unable to obtain the flexed position and may have difficulty bringing their hands to their mouth to soothe. The mothers are encouraged to handle their babies with slow and gentle movements and are shown that unnecessary handling should be kept to a minimum so that the infant's energy is conserved for growth.[53]

3.2.1 Sampling

Convenience sampling was used in this research, as the infants and caregivers who were already attending the Neonatal and KMC Follow-Up Clinics at CHB Hospital were used in the study. Thus all the infants that were used in the sample were born prematurely at CHB Hospital. This was chosen as the desired method as it was a practical way of accessing infants that were born prematurely and who had undergone different methods of neonatal care. The infants chosen to participate in this study were selected according to their age, between 7-12 months (uncorrected), prematurity and APGAR rating taken at 5 minutes.

The following inclusion and exclusion criteria were selected for this study:

3.2.1.1 Inclusion criteria

- Infants born prematurely at CHB Hospital who were admitted during their neonatal care to either the high and medium care wards or the low care KMC ward
- Infants between the ages of 7-12 months (uncorrected age). This age criterion was chosen as the Sensory Profile covers 7-36 months, but most infants are only seen at the Neonatal and KMC Follow-Up Clinics until approximately 12 months (corrected age).

3.2.1.2 Exclusion criteria

- Infants with a final APGAR score lower than 6/10 (taken 5 min after birth)
- Infants that had a birth weight higher than 1750g
- Infants that had a known confirmed HIV positive status recorded in their hospital file
- Infants with any syndromes or other major health complications

3.2.1.3 Sample size

A statistician set the sample size, with at least 50 participants (25 per group) having an 80% power to detect a difference between the groups of at least one category on the Infant/Toddler Sensory Profile when testing at the 0.05 level of significance. This follows from the difference that there is one standard deviation (SD) less or more between the DD, PD and typical performance categories. The proposed number of participants for this study was initially to be 25 infants who were only admitted to the high and medium care wards, having undergone primarily CC, and 25 infants who were admitted from high and medium care to the low care KMC ward for exclusive twenty-four hour KMC.

There were 48 infants who were born prematurely in the actual sample and their caregivers. Of this total sample, 14 infants had undergone primarily CC in high and medium care and were not admitted to the low care KMC ward, while 34 had been admitted from high or medium care to the low care KMC ward where exclusive KMC is practiced for twenty-four hours a day and mothers are involved in a fulltime KMC programme.

The small sample of infants who received mainly CC affected the power to detect the difference between the two groups, which may have resulted in a Type II measurement error, and the incorrect acceptance of the null hypothesis. The external validity of the study is also affected, as the results for this group cannot be generalised to other samples or populations.

3.3 MEASUREMENT TECHNIQUES

Data for the research was collected using the standardised Infant/Toddler Sensory Profile and a short background information questionnaire. The information was obtained by the completion of the following:

3.3.1 Cover sheet (Appendix D)

This was a short demographic questionnaire drawn up by the researcher. It contained the following: participant name, participant number, date of assessment and contact details for the participant. Prior to the data collection, the researcher and research assistant completed the cover sheet that was removed from the background information questionnaire and Sensory Profile during data analysis so that confidentiality of the subjects participating in the research was ensured. The Sensory Profiles were only scored on completion of the data collection so as to avoid any bias when scoring and analysing the results. On completion of the study, these details were used to contact caregivers whose infants presented with a significant sensory processing problem, and further information regarding assessment and treatment options was then offered to these caregivers.

3.3.2 Background information questionnaire (Appendix E)

This self-administered questionnaire was developed to obtain personal background, medical history and other information pertaining to the sensory functioning of the premature infants in the sample. The primary caregiver completed this with the researcher/research assistant available if assistance or translation was required.

3.3.3 Hospital file and Road-to-Health Chart (RTHC) review

All infants' outpatient hospital files and RTHC's were reviewed by the caregiver and researcher/research assistant to obtain/confirm information needed for the completion of the above-mentioned background information questionnaire. The caregiver was required to tick the relevant block or give a simple written answer where required.

3.3.4 Infant/Toddler Sensory Profile (Appendix F1)

The Sensory Profile is a self-administered caregiver questionnaire consisting of 48 items for children aged 7-36 months. These 48 items are further divided into sensory systems. The caregiver completed the Infant/Toddler Sensory Profile by reporting on the frequency with which these behaviours occurred, ticking the relevant option. The responses that the caregiver could choose between included "When presented with the opportunity, your child…. **almost always** (90% or more of the time)/ **frequently** (75% of the time)/ **occasionally** (50% of the time)/ **seldom** (25% of the time) /**almost never** (10% or less of the time)… responds in this manner".[10]

The researcher then scored the responses using the Sensory Profile's summary score sheet (Appendix F2). Each response was given a score of 1-5, **1** corresponding with **almost always**, **2** with **frequently**, **3** with

occasionally, **4** with **seldom**, and **5** with **almost never**. The scores were then added within each sensory system to get a total raw score for the sensory processing of each system. The scores of specific questions marked on the profile were totalled to obtain the combined quadrant scores, for low registration, sensation seeking, sensory sensitive and sensation avoiding profiles. All these scores were then plotted on a grid to see whether the child's performance was in the typical performance range or in the PD and DD- "*more than others*" or "*less than others*"- categories.

Scores that fall into the "*more than others*" PD and DD categories indicate that the child is more responsive in that area than his/her peers. Scores that fall into the "*less than others*" PD and DD categories indicate that a child is less responsive in comparison to his/her peers in the area assessed. Scores outside + or -2 SD from the mean for children of this age corresponds to DD and scores + or -1 to + or -2 SD range corresponds to PD. Typical performance corresponds to scores at or between + or -1 SD from the mean for children of this age. All scores falling out of the typical range require further consult and follow-up with an SI therapist.[10] It must be noted that for the purposes of this study all mean scores obtained were rounded up from .51 and down from .49, according to the round half up tie-breaking rule. This was done so that the scores could be placed into a specific category on the Sensory Profile, which works on whole numbers. It must be noted that scores that ended in .50, were rounded up if odd but left as is if even, so as to avoid bias in rounding.[54]

The Sensory Profile was explained in detail to the primary caregiver prior to completion, so that he/she understood the rating scale used to complete the form. The primary caregiver was required to complete the form in English but a Zulu/Sotho speaking research assistant was available to translate any unclear questions and to assist the caregiver with the completion of the Infant/Toddler Sensory Profile.

3.4 RESEARCH PROCEDURE

The research was carried out at CHB Hospital's Neonatal and KMC Follow-Up Clinics. The Neonatal Follow-Up Clinic runs once weekly at CHB Hospital's Neonatal Unit and the KMC Follow-Up Clinic runs two to three times weekly at the low care KMC ward. The caregivers and infants wait to be seen by the medical staff in long queues in a waiting room. The research assistant invited the relevant participants to participate in the research while they were awaiting their appointments. They are given a queue number when they arrive in the morning for the clinic, so they did not lose their place in the queue while they participated in the study.

The first step was the application for ethical clearance, which was obtained on 21 January 2009 and the clearance certificate is attached in Appendix G. An application to the CEO, the Head of Research and the Head of Neonatology at CHB Hospital was submitted to request permission to conduct the research (Appendix A) and permission to conduct the research was obtained (Appendix B).

One occupational therapist and one occupational therapy assistant working at the Occupational Therapy Department at CHB Hospital acted as research assistants. They assisted with the data collection together with the primary researcher. One research assistant was primarily involved in liaising with the neonatology multi-disciplinary team, and the other research assistant helped with translation of any unclear questions and assisted the caregivers with the completion of the Infant/Toddler Sensory Profile where needed. The research assistants were trained in the Infant/Toddler Sensory Profile and the occupational therapy assistant helped with explanations and translation where required.

The sample was recruited, according to the inclusion and exclusion criteria described above. The researcher/research assistants then screened the clinics weekly to recruit participants that met the inclusion and exclusion criteria for this study. Convenience sampling was used by approaching all mothers waiting in the queue at the Neonatal and KMC Follow-Up Clinics to briefly ask them about their child's prematurity, neonatal care and current chronological age. Those that met these criteria for inclusion in this study were then investigated further to establish if they were excluded on any basis.

Once participants were recruited, an information sheet was given to the caregiver explaining the purpose of the study and the caregiver either agreed/disagreed to complete the self-administered questionnaires. Those that agreed to participate were asked to complete the background information questionnaire and the Infant/Toddler Sensory Profile while awaiting their appointments in a separate area of the waiting room. If the infant was awake, another mother waiting in the queue looked after the infant while the caregiver completed the questionnaire. A Zulu/Sotho speaking research assistant was available to assist with translation of any unclear questions and to assist with the completion of the Infant/Toddler Sensory Profile when it was required. There are two items that contained a double negative (items 18 & 44), so the assistant was trained to explain and translate these specific items before completion of the Sensory Profile to avoid any confusion or misinterpretation. A review of the infant's outpatient hospital file and RTHC was done to obtain/confirm background information that was required for the study.

The data collection process was carried out over a period of seven months, as infants meeting the selection criteria were not frequently found at the clinics. Once data collection was complete, a letter of thanks was sent to the relevant staff at CHB Hospital for their cooperation with and involvement in the research (Appendix H).

During the data analysis, the Sensory Profiles and background information questionnaires were analysed anonymously according to a subject number, as the front face sheet was removed by the research assistant prior to scoring and placed in a different venue. The Sensory Profiles were scored separately on completion of the data collection so that the researcher was blinded as to the clinic that the infant had attended.

3.5 ETHICS

Ethical clearance was obtained by the Ethics Committee on 21 January 2009 and the clearance certificate is attached in Appendix G. Participants were invited to volunteer for the research study and could either accept or reject the completion of the Sensory Profile and background information questionnaire. They received an information sheet (Appendix C1) explaining the study and were asked to sign informed consent (Appendix C2) for their infant's medical records to be reviewed. The other data was obtained via self-report questionnaires, and completion of these was assumed as informed consent.

Confidentiality was ensured by the use of a cover sheet (Appendix D) on which personal identifying details were recorded. Each subject was given a number on the cover sheet and this front sheet was removed by the research assistant prior to scoring and placed in a different venue. The Sensory Profile and background information questionnaire only reflected the subject number so that there was no identifying information on these sheets.

Participants had the right to withdraw from the research at any time and were allowed to request feedback at any stage during the research. Caregivers were able to complete the questionnaires in a separate area in the waiting room to ensure privacy.

The caregivers of the infants that were identified with significant sensory processing difficulties were contacted and provided with names and numbers of service providers where their child could go for therapy. Alternatively they were given an appointment for an assessment with a relevant therapist in the Paediatric Department at CHB Hospital. It must be noted however that certain subjects could not be reached, as the contact details and cell phone numbers provided in the study did not exist anymore.

3.6 DATA ANALYSIS

Descriptive statistics were used to analyse the demographic profile of the study sample as obtained from the background information questionnaire.

The following were included in the statistical data analysis:

- Descriptive statistics to summarise the demographics of the caregivers and the infants.
- Descriptive statistics to profile the sensory processing of infants born prematurely on the Infant/Toddler Sensory Profile and to compare the sensory processing scores for each sensory system and combined quadrant scores for behavioural responses to sensory stimuli with the typical scores of the Sensory Profile.
- Descriptive statistics to analyse the sensory processing of infants born prematurely that underwent different methods of care in the neonatal unit. Student t-tests were used to compare the Sensory Profile scores of those infants admitted to high and medium care with those who were admitted to the KMC low care ward.
- Section analysis of the reliability and validity of the Infant/Toddler Sensory Profile with the sample in this study using a Cronbach's alpha.

CHAPTER 4 - RESULTS

These results are based on the Sensory Profiles of 48 infants born prematurely who underwent different methods of neonatal care at CHB Hospital. The demographics of the caregivers and infants, as well as the entire Sensory Profile, are presented for the total group of premature infants. Various aspects of the Sensory Profile, such as the sensory processing and quadrant scores are also considered.

Two groups were identified in the total sample, 14 of these infants had undergone primarily CC in the high and medium wards (CC group), while 34 had been admitted from high or medium care to the low care KMC ward where mothers are involved in a fulltime twenty-four hours a day KMC programme (KMC group). Differences in the demographics of the infants from these two groups were analysed, as well as a comparison of the Sensory Profiles of these two groups. The reliability and validity of the Sensory Profile for this South African sample population was investigated using Cronbach's alpha.

4.1 DEMOGRAPHICS OF THE STUDY SAMPLE

4.1.1 Caregivers

When considering gender, age and home language, 97.90% of the caregivers were female. Their ages ranged from 16-40 years but the highest percentage (27.08%) of caregivers were between the ages of 26-30 years (Table 4.1). Only 8.33% of the caregivers spoke English as a home language (Table 4.1).

Table 4.1 Gender, age and language group of caregivers that participated in this study

	n= 48
Gender	
Female	97.90%
Male	2.08%
Age (Years)	
16-20	8.33%
21-25	22.90%
26-30	27.08%
31-35	25.00%
36-40	16.66%
Home language	
English	8.33%
Zulu	22.91%
Sotho	20.83%
Xhosa	18.75%
Other African languages	29.16%

In Table 4.2 below, 52.08% of the caregivers in this study had only obtained a high school level education. A higher percentage (70.83%) of the caregivers were unemployed and 62.5% of caregivers had an income of between R0-R1000 a month (Table 4.2).

Table 4.2 Education level, employment and income bracket of caregivers that participated in this study

	n= 48
Highest level of education	
No formal education	0%
Primary School education	12.5%
High School education	52.08%
Tertiary education	29.17%
Informal Training	2.08%
Not given	4.17%
Currently employed	
Yes	29.17%
No	70.83%
Income bracket	
R0-R1000	62.5%
R1000-R2000	12.5%
R2000-R4000	14.58%
R4000-R6000	6.25%
R6000-R10000	4.17%
R10000 +	0%

In terms of family structure, Table 4.3 indicates that the majority of the caregivers (70.83%) were single. Most caregivers had given birth to either one or two children and the greatest number of children being born to any caregiver was four (Table 4.3).

Table 4.3 Marital status and number of children born to caregivers that participated in this study

	n= 48
Number of children	
1	35.42%
2	33.33%
3	14.58%
4	16.67%
5+	0%
Marital status	
Married	29.17%
Single	70.83%
Divorced	0%
Widowed	0%

4.1.2 Infants

The demographics of the infants included their personal history in terms of age, gender, birth order and other children living in the household.

Table 4.4 Chronological age and gender of the infants that participated in this study

	n= 48
Chronological age range	7 months 2 days – 12 months 23 days
Gender	
Male	43.75%
Female	56.25%

The ages of the infants in this study ranged from 7 months 2 days to 12 months 23 days (Table 4.4). As noted above in Table 4.4, there were slightly more females (56.25%) in the study than males (43.75%).

Other demographic factors considered were weeks of gestation, gender, birth order and the number of children between the ages of 0 to 18 years living in the household.

Table 4.5 Weeks gestation and birth order of the infants that participated in this study and the number of children living in the home

	n= 48
Average gestation	31.19 weeks
Weeks gestation	
26-27	8.33%
28-29	18.75%
30-31	22.92%
32-33	29.17%
34-35	8.33%
36-37	12.5%
Birth order	
1^{st}	39.58%
2^{nd}	31.25%
3^{rd}	20.83%
4^{th}	8.33%
5^{th}	0%
More than 3 children living in the house	
Yes	20.83%
No	79.17%

In Table 4.5 above it is noted that the average gestational period of the premature infants was 31.19 weeks. A higher percentage (39.58%) of the infants were first born and the majority of infants came from a household with less than three children living in the house (Table 4.5).

4.2 MEDICAL INFORMATION OF THE TOTAL SAMPLE OF INFANTS

Medical information of the infants was established and included the average length of hospital stay, birth and discharge weights.

Table 4.6 Average length of stay, birth weight and discharge weight for the infants that participated in this study

	n= 48
Average length of hospital stay	31.05 days (Data unavailable: 6)
Average birth weight	1345.10g
Average discharge weight	1680.17g (Data unavailable: 2)

Table 4.6 shows that the average length of stay for the infants in this study was 31.05 days, with average birth and discharge weights of 1345.10g and 1680.17g respectively. It must be noted that some of the above mentioned data was unavailable in the medical records or charts reviewed for this research.

The majority of infants (70.83%) were not referred for any therapy although problems of developmental delay were reported for many infants (Table 4.7). Of this sample of premature infants, 56.25% were admitted to ICU for some period of time during their hospital admission (Table 4.7).

Table 4.7 ICU admission and therapy received by the infants that participated in this study

	n=48
ICU admission	
Yes	56.25%
No	43.75%
Therapy received	
Speech therapy & audiology	10.42%
Physiotherapy	14.58%
Occupational therapy	4.17%
None	70.83%
Most common complications and problems reported	Developmental delay, blocked nose, rashes and chest related complaints

4.3 SENSORY PROFILES OF THE TOTAL SAMPLE OF INFANTS

The Sensory Profiles of the total sample of premature infants in the study were analysed to compare their scores against the typical performance range. The mean and standard deviation scores for the sensory processing sections and quadrants were included.

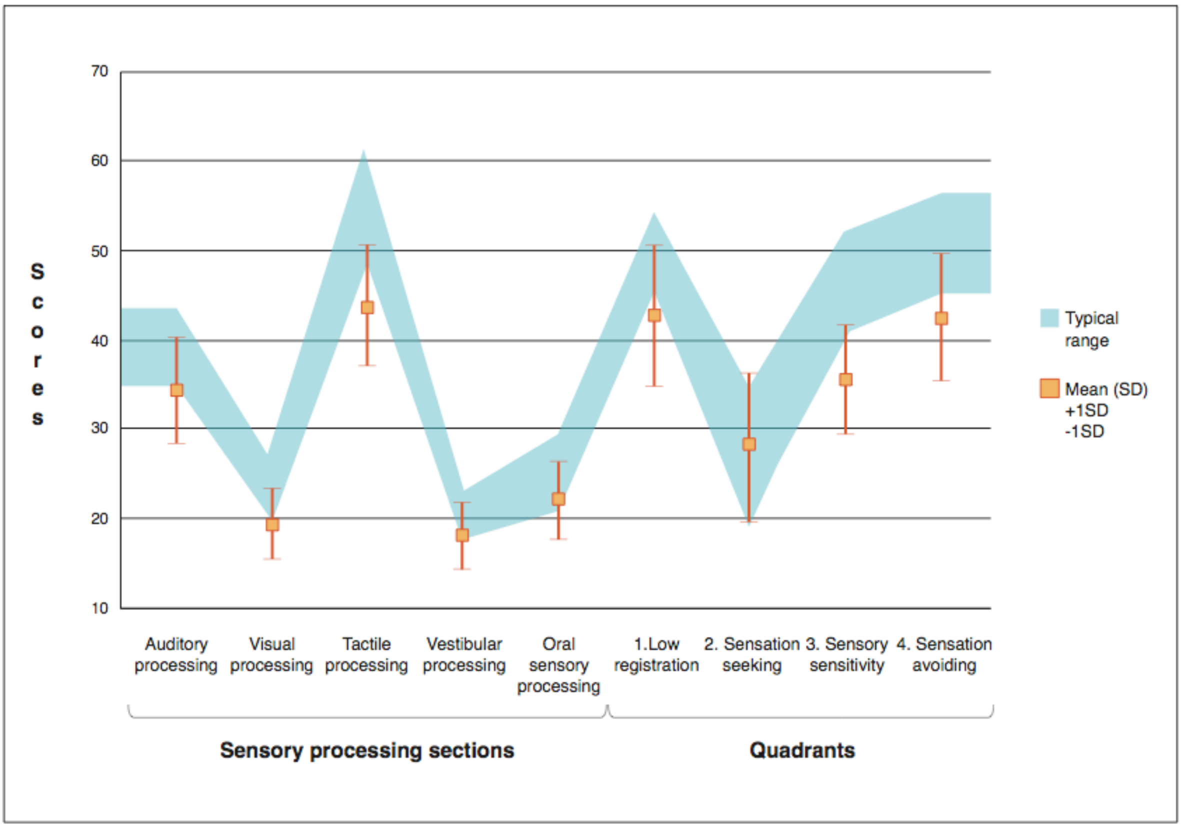

Figure 4.1 Mean scores for the premature infants in relation to typical range of scores

In Figure 4.1 above the typical performance range of scores was indicated to show how the infants' mean scores related to the normal range. On review of the mean scores for the total sample of infants, auditory, visual and tactile processing scores were all found to fall in the atypical PD "*more than others*" category. In Table 4.8 it was noted that the auditory and visual processing mean scores only fell marginally outside the typical range. Mean scores for oral and vestibular processing fell within the typical range. Quadrants 1 (low registration), 3 (sensory sensitivity) and 4 (sensation avoiding) had mean scores that fell in the PD and DD "*more than others*" categories. Only quadrant 2 (sensation seeking) indicated a mean score that fell in the typical range for all infants (Figure 4.1 & Table 4.8).

Table 4.8 Sensory Profile mean and standard deviation scores for the premature infants (n=48)

Sensory processing sections	**Typical Performance**	**Mean (SD)**
Auditory processing	43-35	34.31 (5.99)
Visual processing	27-20	19.31 (3.79)
Tactile processing	61-48	43.88 (6.83)
Vestibular processing	23-18	18.15 (3.76)
Oral sensory processing	29-21	22.04 (4.35)
Quadrants		
1. Low registration	54-46	42.81 (7.89)
2. Sensation seeking	35-19	28.02 (8.17)
3. Sensory sensitivity	52-41	35.56 (6.26)
4. Sensation avoiding	56-45	42.5 (7.1)
Low threshold	107-87	78.06 (11.91)

4.3.1 Sensory Profile processing sections

The sensory processing sections for the total group of infants were analysed to establish the percentage of infants falling in each category of the Sensory Profile. The five categories which the infants could score in were DD and PD "*less than others*", typical performance, and PD and DD "*more than others*".

On analysis of auditory processing in Table 4.9, the premature infants were found to have the highest percentage (52.08%) of infants falling in the PD "*more than others*" category and for visual processing 43.75% of infants fell in the PD "*more than others*" category.

Table 4.9 Sensory processing section summary for the premature infants (n = 48)

	Less than others		**Typical Performance**	**More than others**	
	Definite Difference	**Probable Difference**		**Probable Difference**	**Definite Difference**
Auditory processing	2.08%	0%	43.75%	52.08%	2.08%
Visual processing	0%	0%	39.58%	43.75%	16.67%
Tactile processing	0%	0%	39.58%	16.67%	43.75%
Vestibular processing	2.08%	4.17%	56.25%	25%	12.5%
Oral sensory processing	0%	2.08%	68.75%	20.83%	8.33%

For tactile processing the largest percentage (43.75%) of the infants fell in the DD "*more than others*" category. The percentages of infants falling in the typical performance range for vestibular and oral sensory processing were 56.25% and 68.75% respectively (Table 4.9).

In Table 4.9 it was evident that only a few infants scored in the PD and DD "*less than others*" categories. Overall there were more premature infants that fell in the PD and DD "*more than others*" categories for sensory processing rather than the PD and DD "*less than others*", indicating a possible tendency to be over responsive to sensory input particularly for auditory, visual and tactile stimuli.

4.3.2 Sensory Profile quadrants

The quadrants were analysed to ascertain the percentage of infants falling in each category of the Sensory Profile. The five categories that the infants could score in were DD and PD "*less than others*", typical performance, and PD and DD "*more than others*", as with the sensory processing sections.

Table 4.10 Quadrant summary for the premature infants (n = 48)

	Less than others		**Typical Performance**	**More than others**	
	Definite Difference	**Probable Difference**		**Probable Difference**	**Definite Difference**
1. Low registration	**	4.17%	33.33%	12.5%	50%
2. Sensation seeking	4.17%	16.67%	60.42%	18.75%	**
3. Sensory sensitivity	**	0%	20.83%	37.5%	41.67%
4. Sensation avoiding	**	0%	50%	25%	25%
Low threshold	**	0%	29.17%	*27.08%	*43.75%
Relevance of low threshold				*3 of 13 scores were relevant	*All 21 scores were relevant

**There can be no definite difference for this section in this age range

*This score is only relevant if both quadrant 3 and 4 are outside the typical range

In Table 4.10, the highest percentage (50%) of infants in quadrant 1 (low registration) scored in the DD "*more than others*" category. This appears to be contradictory to the high low threshold scores obtained for both groups, though this could indicate possible *shut down* and will be explored further in Chapter 5.

Of the 66.67% of premature infants that scored in the atypical range for quadrant 1 (low registration), as indicated in Figure 4.2 below, 27,08% had atypical low registration scores and a further 39.58% had atypical scores for low registration, as well as relevant low threshold scores.

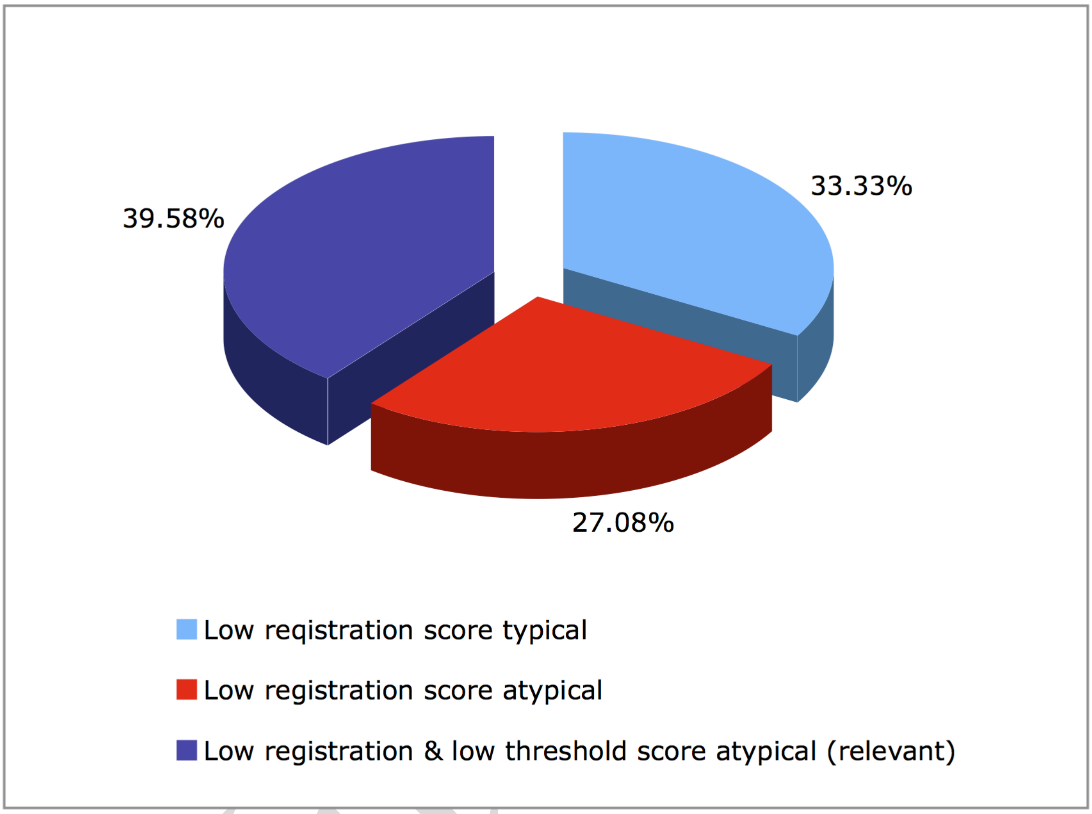

Figure 4.2 Low registration score distribution for the premature infants (n=48)

On analysis of quadrant 2 (sensation seeking), 60.42% of all the premature infants fell in the typical range, where as only 39.58% had atypical sensory seeking scores (Figure 4.3).

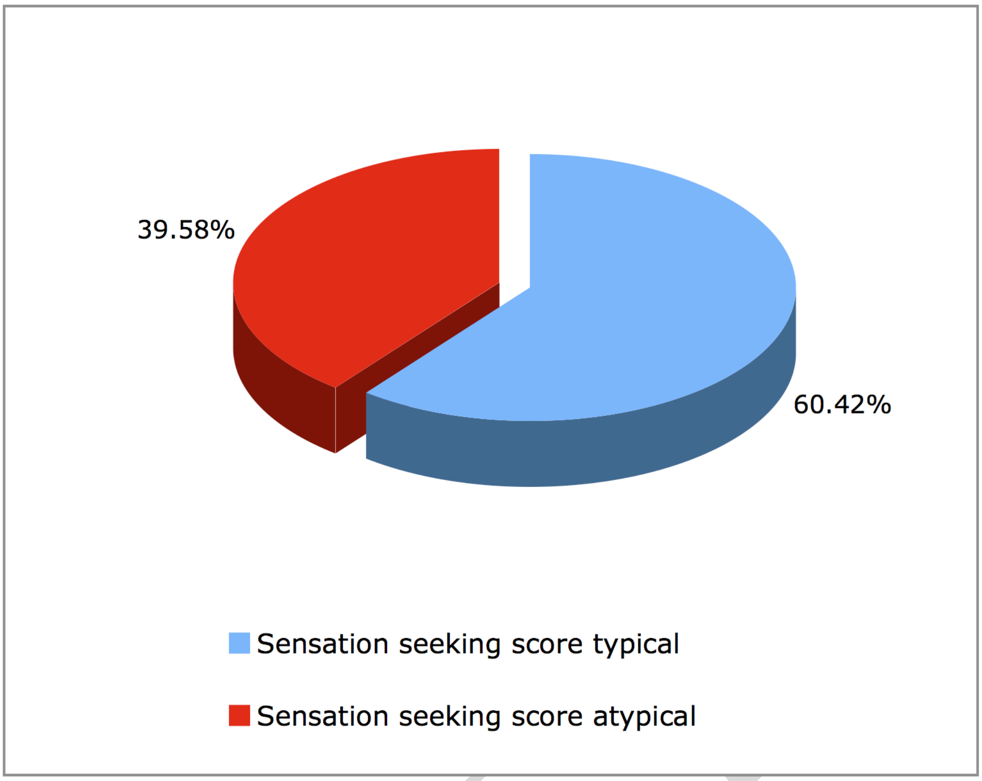

Figure 4.3 Sensation seeking score distribution for the premature infants (n=48)

More premature infants scored in the PD and DD "*more than others*" categories for quadrant 3 (sensory sensitivity) than the typical range. Half of the sample scored in the typical performance range for quadrant 4 (sensation avoiding), and the other half were divided between the PD and DD "*more than others*" categories (Table 4.10).

When reviewing the low threshold scores in Table 4.10, it is important to remember that scores are only considered relevant if the scores of both quadrant 3 and 4 fall in the atypical range. It must be noted that 43.67% of the infants scored in the DD "*more than others*" category and all these scores were found to be relevant. Only three of the 13 infants scoring in the PD "*more than others*" category for low threshold were found to be relevant.

Overall 24 infants had relevant low threshold scores, thereby indicating 50% of the total sample of premature infants as indicated in Figure 4.4 below.

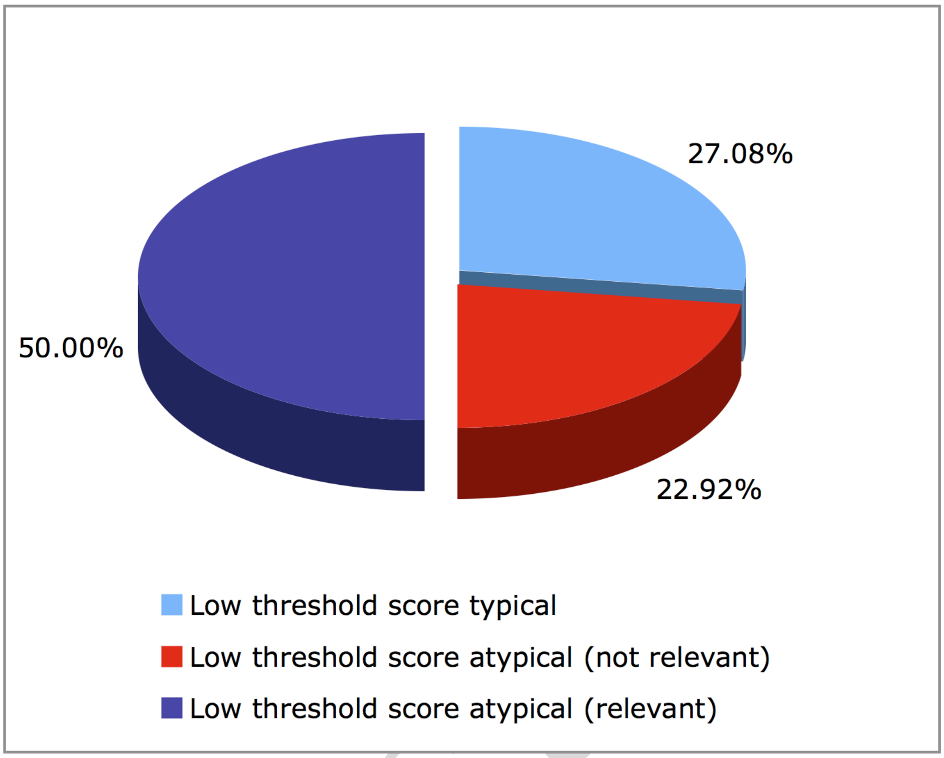

Figure 4.4 Low threshold score distribution for the premature infants (n=48)

4.4 COMPARISON OF THE DEMOGRAPHICS AND MEDICAL INFORMATION OF INFANTS WHO RECEIVED DIFFERENT METHODS OF NEONATAL CARE

Since no statistically significant differences were found between the caregivers of the KMC and CC groups, except for the number of children that the caregivers had given birth to (p=0.04), the caregivers of both groups of infants were therefore considered to be homogeneous (Appendix I Table 4). The infant groups were also considered homogeneous and differed significantly (p=0.02) in gender only (Table 4.11).

Table 4.11 Chronological age and gender of the infants that participated in this study

	KMC group n = 34 infants	**CC group n = 14 infants**	**p value**
Chronological age range	7 months 9 days – 12 months 23 days	7 months 2 days – 12 months 16 days	
Gender			0.02*
Male	32.35%	71.43%	
Female	67.65%	28.57%	

Other demographic factors considered were weeks of gestation, gender, birth order and the number of children between the ages of 0 to 18 years living in the household. The average gestational period was 31.32 weeks for the infants from the KMC group, and 30.86 weeks for the CC infants. A higher percentage (50%) of first born children in this sample fell into the KMC group, where the largest percentages of CC infants were born either second (42.86%) or third (42.86%) (Appendix I Table 5).

In terms of their medical information the average length of stay was similar for both groups of infants. The average birth (1307.94g) and discharge (1667.59g) weights were lower for the KMC group than the CC group, but the difference was not statistically significant (Appendix I Table 6).

Table 4.12 indicates that there was a statistically significant difference (p=0.04) in terms of ICU admissions with more of the CC group (78.57%) being admitted to ICU. Of the CC group, 35.71% also needed supplemental nasal oxygen and a further 14.29% also required ventilation.

Table 4.12 ICU admission, other care and therapy received by the infants that participated in this study

	KMC group n = 34 infants	**CC group n = 14 infants**	**p value**
ICU admission			0.04*
Yes	47.06%	78.57%	
No	52.94%	21.43%	
Other care received			0.40
Oxygen nasal prongs	26.47%	35.71%	
Both oxygen nasal prongs and ventilation	8.82%	14.29%	
No other care received	52.94%	42.86%	
Not noted in file	11.76%	7.14%	
Therapy received			0.84
Speech therapy & audiology	14.71%	0%	
Physiotherapy	8.82%	28.57%	
Occupational therapy	0%	14.29%	
None	76.47%	57.14%	

*Significance p≤ 0.05

The infants in the CC group were also more likely to have had occupational and physiotherapy (Table 4.12).

4.5 COMPARISON OF THE SENSORY PROFILES OF INFANTS WHO RECEIVED DIFFERENT METHODS OF NEONATAL CARE

The infants' Sensory Profiles were compared to ascertain if there were any differences between those who had undergone primarily CC in the high and medium care wards and were not admitted to the low care KMC ward (CC group) and those who had been admitted to the low care KMC ward where exclusive KMC is practiced for twenty-four hours a day and mothers are involved in a fulltime KMC programme (KMC group). The mean and standard deviation scores for the sensory processing sections and quadrants were included to see whether the two groups differed from the typical performance range.

Table 4.13 Sensory Profile mean and standard deviation scores for infants participating in this study

	Typical Performance	KMC Group n = 34 infants	CC Group n = 14 infants	p value
Sensory processing sections		**Mean (SD)**	**Mean (SD)**	
Auditory processing	43-35	34.71 (5.77)	33.36 (6.64)	0.48
Visual processing	27-20	19.68 (3.3)	18.43 (4.8)	0.30
Tactile processing	61-48	42.56 (5.92)	47.07 (8.0)	0.04*
Vestibular processing	23-18	17.88 (3.33)	18.79 (4.73)	0.46
Oral sensory processing	29-21	22 (4.01)	22.14 (5.25)	0.92
Quadrants				
1. Low registration	54-46	43.12 (7.7)	42.36 (8.59)	0.76
2. Sensation seeking	35-19	27.74 (8.28)	28.71 (8.16)	0.71
3. Sensory sensitivity	52-41	35.24 (5.86)	36.5 (7.26)	0.53
4. Sensation avoiding	56-45	42.32 (6.76)	42.93 (8.12)	0.79
Low threshold	107-87	77.55 (10.97)	79.43 (14.31)	0.63

*Significance p≤ 0.05

A two-sample t-test with equal variances was conducted on all sensory processing and quadrant scores to ascertain whether there was a significant difference in scores between the groups of infants that participated in this study. As indicated in Table 4.13, the only sensory processing section that displayed a statistically significant difference between the two groups was tactile processing (p=0.04), where the CC group scored closer to the typical performance range than the KMC group. Auditory, visual, vestibular and oral sensory processing scores did not differ significantly for both groups. There was no significant difference between the groups in any of the quadrant scores (Table 4.13).

Higher standard deviations were noted for all sensory processing sections in the CC group indicating greater variance in this small sample (n=14) than was found in the larger KMC group. This was especially true for tactile processing (Table 4.13) indicating that there may have been a greater margin of error in the results of the CC group.

When the spread of scores for each question on the Infant/Toddler Sensory Profile was analysed, the only question that differed significantly (p=0.04) for the two groups was Question 30 that states, “My child becomes anxious when walking or crawling on certain surfaces”. Significantly more of the infants in the group that received CC only scored a **1**, which correlates with a behavioural response of **almost always** for this question (Appendix I Table 3).

4.5.1 Sensory Profile processing sections

Table 4.14 indicates that for auditory, visual and tactile processing less than half the infants in either group fell into the typical range, with the exception of tactile processing for the CC group. For vestibular and oral sensory processing both groups had 50% or more of the infants scoring in the typical performance range.

For both groups the highest percentage of infants fell in the PD “*more than others*” category for auditory processing at 50% for the KMC group and 57.14% for the CC group.

Table 4.14 Sensory processing section summary for the KMC group (n = 34) and CC group (n=14)

		Less than others		Typical Performance	More than others	
	Group	Definite Difference	Probable Difference		Probable Difference	Definite Difference
Auditory processing	KMC	2.94%	0%	47.06%	50%	0%
	CC	0%	0%	35.71%	57.14%	7.14%
Visual processing	KMC	0%	0%	38.24%	50%	11.76%
	CC	0%	0%	42.86%	28.57%	28.57%
Tactile processing	KMC	0%	0%	29.41%	17.65%	52.94%
	CC	0%	0%	64.29%	14.29%	21.43%
Vestibular processing	KMC	0%	2.94%	58.82%	26.47%	11.76%
	CC	7.14%	7.14%	50%	21.43%	14.29%
Oral sensory processing	KMC	0%	2.94%	67.65%	20.59%	8.82%
	CC	0%	0%	71.43%	21.43%	7.14%

Results for visual processing indicated that more than half of the total sample of infants fell into the PD and DD "*more than others*" categories. The KMC group had 50% of the infants falling in the PD "*more than others*" category and those in the CC group were equally divided with 28.57% in both the PD and DD "*more than others"* categories (Table 4.14).

For tactile processing the largest percentage (52.94%) of infants fell in the DD "*more than others*" category for the KMC group while the largest percentage (64.29%) of infants from the CC group fell in the typical performance range (Table 4.14).

4.5.2 Sensory Profile quadrants

For the KMC group, shown in Table 4.15 below, the highest percentage (47.06%) of infants fell in the DD "*more than others*" category for quadrant 1 (low registration), with 57.14% of the infants in the CC group scoring in the DD "*more than others*" category for quadrant 1 (low registration). Once again this appears to be contrary to the high low threshold scores obtained for both groups, though this could indicate possible *shut down* and will be explored further in Chapter 5.

For quadrant 2 (sensation seeking), 64.71% of the infants from the KMC group and 50% of the infants in the CC group scored in the typical performance range. In the KMC group the largest percentage (47.06%) of infants fell in the DD "*more than others*" category for quadrant 3 (sensory sensitivity), while the highest percentage (50%) of infants in the CC group scored in the PD "*more than others*" category (Table 4.15).

Table 4.15 Quadrant summary for the KMC group (n = 34) and CC group (n=14)

		Less than others			More than others	
	Group	**Definite Difference**	**Probable Difference**	**Typical Performance**	**Probable Difference**	**Definite Difference**
1. Low registration	KMC	**	5.88%	32.35%	14.71%	47.06%
	CC	**	0%	35.71%	7.14%	57.14%
2. Sensation seeking	KMC	5.88%	11.76%	64.71%	17.65%	**
	CC	0%	28.57%	50%	21.43%	**
3. Sensory sensitivity	KMC	**	0%	20.59%	32.35%	47.06%
	CC	**	0%	21.43%	50%	28.57%
4. Sensation avoiding	KMC	**	0%	47.06%	26.47%	26.47%
	CC	**	0%	57.14%	21.43%	21.43%
Low threshold	KMC	**	0%	29.41%	*20.59%	*50%
	CC	**	0%	28.57%	*42.86%	*28.57%
Relevance of low threshold	KMC				*1 of 7 scores were relevant	*All 17 scores were relevant
	CC				*2 of 6 scores were relevant	*All 4 scores were relevant

**There can be no definite difference for this section in this age range

*This score is only relevant if both quadrant 3 and 4 are outside the typical range

For quadrant 4 (sensation avoiding), a higher percentage (57.14%) of infants in the CC group scored in the typical range. The KMC group displayed slightly higher percentages (52.94%) of infants in the PD and DD "*more than others*" categories combined, indicating higher avoidant tendencies in response to sensory stimuli that is perceived to be threatening (Table 4.15).

When reviewing low threshold scores it is important to remember that the score is only considered relevant if both quadrant 3 and 4 have scores falling in the atypical range. As noted in Table 4.15 half of the infants from the KMC group had relevant low threshold scores falling in the DD "*more than others*" category. For the CC group 28.57% of the infants were found to have a relevant low threshold score falling in the DD "*more than others*" category. A higher percentage (42.86%) of scores fell in the PD "*more than others*" category for the low threshold category but only two of these scores were considered to be relevant (Table 4.15).

4.5.3 Sensory Profile individual item analysis

On analysis of the 48 items of the Sensory Profile, only one item, number 30, was found to differ significantly between the two groups of infants. Item 30 falls under the tactile processing section and states, ("My child becomes anxious when walking or crawling on certain surfaces (for example grass, sand, carpet, tile)").

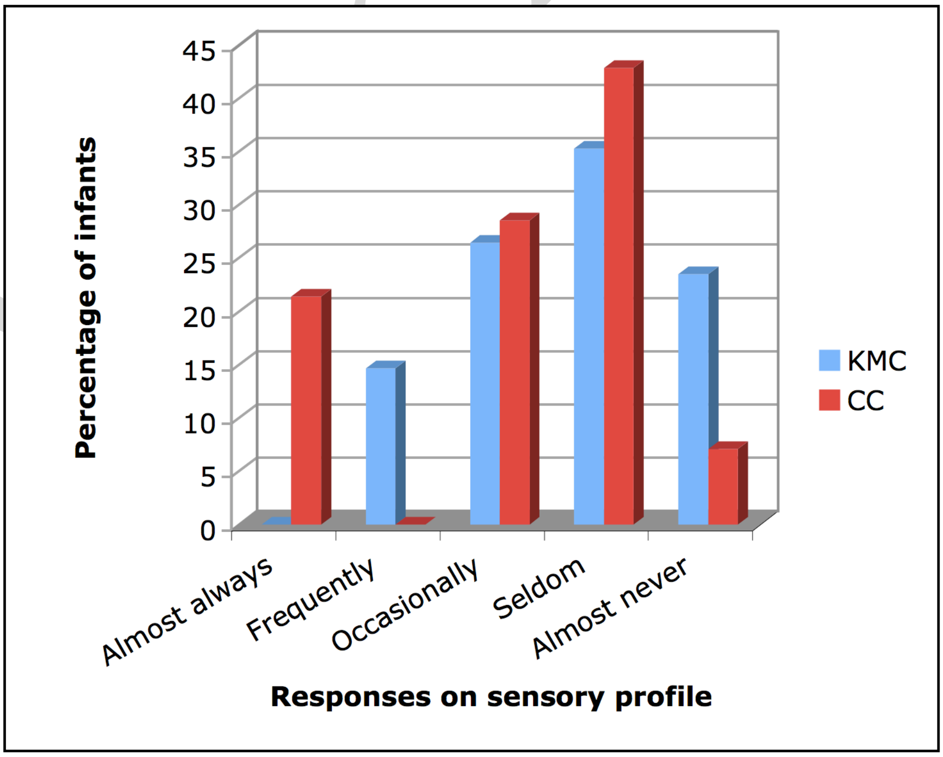

Figure 4.5 Responses to item 30 of the Sensory Profile ("My child becomes anxious when walking or crawling on certain surfaces (for example grass, sand, carpet, tile)")

Item 30 had a Fisher's exact value of p≤0.04. There was therefore a statistically significant difference between the two groups in terms of responses for this item on the Sensory Profile. A response of **almost always**, scoring **1**, was higher in the CC group, which means that the child almost always becomes anxious when placed on the different surfaces mentioned above. The KMC group was found to have higher scores of **4** and **5**, which correlate with behavioural responses of **seldom** or **almost never** on the Sensory Profile. Overall there was a wide range of scores for both groups; it was therefore difficult to isolate a specific trend in behaviour on this particular item of the Sensory Profile (Figure 4.5).

4.6 SENSORY PROFILE AND RELIABILITY WITH THE STUDY SAMPLE

Cronbach's alpha was used to analyse the validity of the Sensory Profile for the sample population. This test looks at the homogeneity of items within a group and whether the questions are interpreted and understood correctly by the caregivers.

Table 4.16 Summary of Cronbach's alpha values for sensory processing sections

	Items	**Alpha value**
General processing	1-3	0.75
Auditory processing	4-13	0.66
Visual processing	14-20	0.64
Tactile processing	21-35	0.50
Vestibular processing	36-41	0.46
Oral sensory processing	42-48	0.59

On analysis of the Cronbach's alpha values obtained in this study, it was found that these values were similar, if not better, for most sensory processing sections than those obtained in the reliability and validity studies conducted on the Sensory Profile as reported by Dunn.[10] The only section which differed was tactile processing and the Cronbach's alpha score in this study was notably lower, possibly indicating poor correlation of items within this group or poor comprehension of the items on the caregivers' part (Table 4.16).

On analysis of the tactile processing section, items 21, 27, 30, 31 and 35 were shown to influence the overall alpha coefficient. Item 21 states, "My child resists being held", item 27 states, "My child avoids contact with rough or cold surfaces", item 30 states, "My child becomes anxious when walking or crawling on certain surfaces", item 31 states, "My child enjoys playing with food" and item 35 states, "My child uses hands to explore food and other textures".

Under the vestibular processing section, items 39 and 40 were shown to influence the overall Cronbach's alpha value for this section. Item 39 states, "My child becomes upset when placed on back to change diapers" and item 40 states, "My child resists having head tipped back during bathing". Items 45 and 46 influenced the overall Cronbach's alpha value for the oral sensory processing section. Item 45 states, "My child refuses all but a few food choices" and item 46 states, "My child resists having teeth brushed".

4.7 SUMMARY

In this chapter, the demographics of the study sample were presented, including a description of the infants and their caregivers. Caregivers were found to be mostly female, single, unemployed and had a monthly income of between R0-1000. The majority did not speak English as their home language. There were more female infants in the study than males and the average gestational period for the infants was 31.19 weeks.

In terms of medical information, the average admission for the infants was 31.05 days and the majority of the infants were not referred for any therapy. Over half of the infants in the study sample were admitted to ICU during their hospital admission. On comparison of the two groups, infants only differed significantly in terms of gender with more males in the CC group. There was also a significant difference in ICU admissions, with more infants from the CC group being admitted to ICU and requiring other medical care.

On analysis of the Sensory Profiles for the total sample, the mean scores for auditory, visual and tactile processing fell in the atypical PD "*more than others*" category. Overall there were more premature infants that fell into the PD and DD "*more than others*" categories for sensory processing rather than the PD and DD "*less than others*", indicating a possible tendency to be over responsive to sensory input particularly for auditory, visual and tactile stimuli. For the quadrant analysis, mean scores fell in the atypical range for quadrant 1, 3 and 4. When reviewing the low threshold scores, 43.67% of the infants scored in the DD "*more than others*" category and all these scores were found to be relevant.

On comparison of the two groups' Sensory Profiles, they were only found to differ significantly in the tactile processing section. Overall, larger percentages of both the KMC and CC group tended to fall in the PD and DD "*more than others*" categories, indicating over responsiveness and sensitivity to sensory input.

On analysis of the Cronbach's alpha values obtained in this study, it was found that these values were similar, if not better, for most sensory processing sections than those obtained in the reliability and validity studies conducted on the Sensory Profile as reported by Dunn.[10] Most sections of the Sensory Profile were found to have a fair reliability for the study sample, as the Cronbach's alpha values compared favorably with those obtained in the initial reliability and validity testing of the Sensory Profile conducted by Dunn. The only section that differed notably was tactile processing, as the Cronbach's alpha score with this study sample was significantly lower, possibly indicating poor correlation of items within this section or poor comprehension of the items on the caregivers' part.

CHAPTER 5 - DISCUSSION

In this chapter the demographics and medical information of the total sample of premature infants at CHB Hospital and their caregivers will be discussed. The Infant/Toddler Sensory Profiles for the total sample of premature infants will be considered in relation to the typical performance of infants in the age group of 7–12 months. This chapter will also consider some of the problems with participant selection and the implications of this, as well as the comparability, in terms of demographics, of the two groups of infants who received different methods of neonatal care and their caregivers. The Infant/Toddler Sensory Profiles of the infants in the KMC group will be compared with those of the infants in the CC group. The reliability, validity and use of the Infant/Toddler Sensory Profile in the context of CHB Hospital will be evaluated.

5.1 DEMOGRAPHICS AND MEDICAL INFORMATION OF THE TOTAL SAMPLE

When looking at the 48 caregivers in this study sample, the caregivers were found to be mostly female and this may be due to the fact that males are only allowed to enter neonatal clinics at CHB Hospital if they have come alone with their infant to consult a medical practitioner. The caregivers' ages ranged from 16-40 years but the highest percentage of caregivers in this study were between the ages of 26-30 years. The caregivers mainly spoke an African language as their home language and only 8.33% of the study sample spoke English as a first language (Table 4.1).

Family and socioeconomic factors have been shown to be affected by the premature birth of an infant which places much strain on the mother-infant bonding process and the family as a whole.[8] As Williamson et al (2008) highlighted, a premature birth has considerable economic implications for families.[26] It must be noted that in the context of this study the majority of the caregivers were single woman who were unemployed, with 62.5% of the caregivers having a household income of less than R1000 per month, thus they already had substantial socioeconomic constraints prior to the birth of their premature infant (Table 4.2). Just over half of the caregivers had only obtained a high school level of education (Table 4.3). Of the caregivers, 35.42% had only given birth to one child but the greatest number of children being born to any given caregiver was four (Table 4.3).

When analysing the premature infants in the study sample, the chronological age range of the infants was found to range from 7 months 2 days to 12 months 23 days and 56.25% of the sample were female (Table 4.4). The higher number of female infants was interesting to note as research has shown that boys are more often born prematurely and are generally less stable than girls after birth with an increased risk for postnatal complications.[28] The average gestational period for the premature infants in this study was 31.19 weeks and it has been shown that babies born this prematurely have organs that are less developed and are at risk for greater complications (Table 4.5).[26,46] It was found that the average admission lasted 31.05 days, though this excluded six of the 48 infants who did not have a discharge date recorded in their hospital file or RTHC. The average birth weight of the infants was 1345.10g, which according to the WHO is referred to as very low birth weight, and the average discharge weight was 1680.17g, which falls into the low birth weight category (Table 4.6).[11]

Infants born prematurely are considered to be “high-risk” infants[16] and in this study 56.25% of the infants were admitted to ICU during their neonatal care (Table 4.7). Although infants are followed-up regularly at the neonatal clinics, a large number of these infants are not referred for screening and assessment of developmental delay and as a result 70.83% of the sample did not access any therapy even though the caregivers reported developmental delay for many of the infants (Table 4.7). This is a high percentage of infants to have not accessed any therapy in a large hospital such as CHB, where supplemental therapy, such as occupational therapy, physiotherapy, speech therapy and dietetics, is available. This indicates a possible problem with the current referral and screening systems that are in place within CHB Hospital's neonatal unit.

The objective of the study was to establish the Sensory Profiles of infants born prematurely at CHB Hospital and in the following section the Sensory Profiles are investigated to determine the sensory processing abilities of the total sample of premature infants.

5.2 SENSORY PROFILES OF THE TOTAL SAMPLE

When considering the Sensory Profiles of the total sample of premature infants, the mean scores of the sensory processing sections and quadrants were analysed in relation to the typical performance range. It was shown that auditory processing, which measures an infant's response to things heard, and visual processing, which measures an infant's response to things seen, fell just within the atypical PD "*more than others*" category. Tactile processing, which measures an infant's response to touch, fell well into the atypical PD "*more than others*" category. This indicates that the average infant in this study had difficulty processing auditory, visual and tactile stimuli regardless of the method of premature neonatal care that they received, displaying a tendency of over responsiveness to input received from these senses (Figure 4.1 & Table 4.8).[10]

On analysis of the percentage of infants that fell into each category of the Sensory Profile, auditory processing had the highest percentage (52.08%) of infants falling into the PD "*more than others*" category and for visual processing 43.75% of infants fell in the PD "*more than others*" category. For tactile processing the largest percentage (43.75%) of the infants fell in the DD "*more than others*" category (Table 4.9). This concurs with the findings of Faure and Richardson (2008) who are of the opinion that premature infants are more sensitive or over responsive to sensory stimuli than infants that are born full term.[19]

The results of this study reflect other findings in the literature, which indicate that premature infants are frequently bombarded by visual, auditory and tactile stimuli, such as bright light, noise and exposure to painful procedures, particularly in the NICU environment. Sizun (2004) highlights the effect of light and sound in NICU's which results in environmental stressors that are known to cause behavioural and physiological disorganisation.[41] These premature infants have immature nervous systems and they have difficulty warding off this visual, auditory and tactile stimulation.[24] As a result premature infants become easily over aroused and have been shown to have ineffective ways of self-regulating or calming themselves when over stimulated.[16]

The total sample of infants in this study displayed mean scores that fell in the typical performance range for vestibular processing, which is an infant's response to movement. The percentages of infants falling in the typical performance range for vestibular processing were high- 56.25%, which indicates that the infants' processing of vestibular sensory stimuli tended to be more typical (Table 4.9). The average infant in this study therefore displayed normal behavioural responses to vestibular stimuli, indicating typical performance for this age group (Figure 4.1 & Table 4.8).[10]

These findings are similar to those of Caprio et al (1998), who found no significant difference in reactivity to vestibular stimulation on the Test of Sensory Function in Infants (TSFI) between preterm infants and full term infants.[32] Research by Santman Weiner et al (1996) however differed somewhat when they administered the TSFI to infants born prematurely and with regulatory difficulties. They found that at 7-12 months (corrected age) mean scores for infants born prematurely fell in the at-risk range for reactivity to vestibular stimulation indicating difficulty processing vestibular input.[25] They did however recommend further clinical studies to standardise the TSFI for the preterm infant.[32]

Santman Weiner et al (1996) also found that premature infants did not present with oral sensitivity that was significantly different from normal infants at 7-10 months (corrected age) although both groups in their study fell into the at-risk group.[25] The infants in this study fell into the typical range for oral sensory processing, which is an infant's response to touch, taste and smell stimuli to the mouth (Figure 4.1 & Table 4.8).[10] There were higher percentages of infants falling in the typical performance range for oral sensory processing than any of the other categories- 68.75% (Table 4.9). The researcher felt that African culture might play a role with the typical oral sensory processing scores obtained in this study, as caregivers expressed that fussiness over food is not a great concern with infants. This is probably due to the socioeconomic context of caregivers in this study, as they tend to give infants limited foods like porridge and milk, or continue to breast feed even at 12 months resulting in a very limited range of tastes and textures being administrated orally.[43,44]

For quadrant 1 (low registration), the mean score for the premature infants was found to fall in the PD "*more than others*" category (Figure 4.1 & Table 4.8). In terms of percentages of infants, half of the infant sample scored in the DD "*more than others*" category for this quadrant (Table 4.10). A low registration infant according to Dunn usually has high neurological thresholds and a tendency to act passively in relation to those thresholds.[10] These infants appear to be disinterested, have a flat affect, low energy levels and are overly tired.[10] Ayres described these infants as having inadequate registration of incoming sensory stimuli.[37] This contradicts the results of quadrant 3 (sensory sensitive), quadrant 4 (sensation avoiding) and certain sensory processing sections, which indicated that the infants were more responsive to sensory input than their peers. The researcher feels that a possible explanation for these low registration scores could be the state of *shut down*. The term *shut down* was first described by Kimball, which indicated a state of behaviour and protective response to sensory overload.[37] She described that some low threshold children react to severe overload and over arousal by going into physiological shut down.[37] This could be the case with these infants, as when in a state of *shut down* a child tends to appear to have low awareness of sensory stimuli. Dunn (2002) confirmed these results when she reported that certain groups of infants, including developmental delays and sensory integrative dysfunction, showed trends on the Infant/Toddler Sensory Profile for lower quadrant 1 (low registration) and low threshold scores, which she felt indicated poor modulation (Figure 4.2).[10]

The mean scores for quadrant 2 (sensation seeking) fell in the typical performance range for the total sample of infants (Figure 4.1 & Table 4.8). This indicates that these infants do not display a sensation-seeking tendency.[10] The sensation seeking behaviour displayed by these infants is therefore within normal limits for their age group. This was confirmed by the 60.42% of infants who scored in the typical performance range for this quadrant (Table 4.10 & Figure 4.3). This contradicts Case-Smith el al's (1998) findings that showed preterm infants to display high activity levels and sensory-seeking behaviours in comparison to the full term infants.[15] The researcher felt that the typical mean score that was obtained for vestibular processing may have accounted for quadrant 2 (sensation seeking) being in the same range. This is because sensory seeking is usually sought within the vestibular and proprioceptive systems, with additional movement and deep touch input required throughout daily routines.[34]

When considering quadrant 3 (sensory sensitivity), the mean scores for the infants who were found to fall in the PD "*more than others*" category (Figure 4.1 & Table 4.8). Only 20.83% of these premature infants scored in the typical performance range for quadrant 3 (sensory sensitivity) and 79.17% scored in the PD and DD "*more than others*" categories combined (Table 4.10). This indicates that the total sample of infants tend to have low neurological thresholds, with sensitivity to incoming sensory stimuli, and they can be distractible or appear hyperactive.[10] They tend to have difficulty habituating to stimuli and as a result attend to each new incoming stimulus that is available in the environment.[10]

The infants' mean score for quadrant 4 (sensation avoiding) was found to fall in the PD "*more than others*" category (Figure 4.1 & Table 4.8). Half of the infants scored in the typical performance range for this quadrant but a quarter of the infants scored in the PD and DD "*more than others*" categories respectively (Table 4.10). This indicates that half of the infants had low neurological thresholds but tended to work actively to avoid stimuli or situations that may be uncomfortable or frightening to them.[10] They can appear to be disruptive children, as they tend to avoid and withdraw from certain situations.[10]

Dunn (2002) introduced a low threshold score on her Sensory Profile, which combines the scores of both quadrant 3 (sensory sensitive) and 4 (sensation avoiding). This score is only considered to be significant if both quadrant 3 and 4 fall out of the typical range.[10] The low threshold mean score for the infants in this study fell in the PD "*more than others*" category (Table 4.8). When reviewing the percentages of infants falling in each category of the Sensory Profile for this low threshold section, 43.75% of the infants fell in the DD "*more than others*" category and all these scores were considered to be relevant (Table 4.10). Furthermore, 27.08% of the total sample of infants fell in the PD "*more than others*" category but only three of the thirteen infants scoring in this category had relevant low threshold scores (Table 4.10). This indicates that many of the infants in the study sample displayed a low neurological threshold.

From these results it was concluded that 50% of the total sample of premature infants participating in this study were low threshold infants, with a combination of both active and passive self-regulation strategies (Figure 4.4).[10] A low threshold score is indicative of a possible sensory modulation dysfunction, though further consult and follow up is required to make a definite diagnosis.[12] Sensory modulation difficulties disrupt the infant's ability to achieve and maintain optimal performance required to cope with environmental challenges due to poor regulation of incoming sensory input.[12] The results of this research are therefore in keeping with current literature, which shows that premature infants are at risk for sensory processing problems along with other areas of developmental delay.[15,16,19] According to Anzalone and Murray (2002), premature infants exhibit behaviours that are consistent with sensory processing dysfunction and they tend to become easily over aroused.[16] Faure and Richardson (2008) are of the same opinion stating that premature infants are more sensitive to sensory stimuli than infants that are born full term.[19]

Sensory modulation has been proven to have links to the autonomic nervous system, as documented by Miller and her colleagues (2001) who found that children with poor sensory modulation are behaviourally over responsive to sensory input displaying significant markers of sympathetic dysfunction when compared to typically developing children. They also found a correlation between the sympathetic over activity and abnormal behavioural responses as measured by the Short Sensory Profile.[2] Studies have also shown that preterm infants have difficulty regulating autonomic functioning[8,24], and this may be why the results indicate possible sensory modulation difficulties for half of the premature infants in this study. Miller et al (2001) draws attention to the fact that sensory modulation is also influenced by external factors such as culture, environment and relationships.[38] This is particularly relevant for this study sample at CHB Hospital, as infants and caregivers came from a low socio-economic level with significant stressors such as lack of education, limited finances and lack of resources, which may have further impacted on the sensory processing of these infants.

Premature infants have immature nervous systems, which result in difficulty achieving homeostasis, which is critical for self-regulation.[7,8] This is true for this sample as 50% of these premature infants were found to be low threshold infants, which according to Dunn (2002) have difficulty with self-regulation and are described to be fussy, irritable and inconsistent in their behaviour (Figure 4.4).[10] A further 27.08% of the total sample of infants that participated in this study, who were not low threshold infants, scored in the atypical range for quadrant 1 (low registration) (Figure 4.2). For quadrant 2 (sensation seeking), 18.75% of the total sample of infants scored atypically in the PD "*more than others*" category and 20.83% scored atypically in the PD and DD "*less than others*" categories (Table 4.10). These findings are supported by those of Janssens et al (2009) who found in their study that psychopathology was 4 to 5 times higher in preterm infants using the Diagnostic Classification zero to three. They used the Infant/Toddler Sensory Profile as one of the assessment instruments for Axis I and found that compared to full term infants the preterm infants had significantly more diagnoses on Axis I. They reported higher incidences of regulatory and attention disorders, and difficulty processing sensory, physiological, motor, cognitive and affective experiences amongst preterms.[33]

5.3 COMPARISON OF THE INFANTS WHO RECEIVED DIFFERENT METHODS OF NEONATAL CARE

One of the secondary objectives of the study was to establish if the two groups of infants who received different methods of neonatal care presented with any notable differences in terms of sensory processing. On initiation of this study, the researcher hoped to compare the sensory processing of prematurely born infants who had received either KMC or CC, so as to ascertain whether a particular method of neonatal care has an influence on sensory processing at a later stage of development. However, when infants who received KMC were recruited it was found that all KMC infants at CHB Hospital had undergone some length of CC for stabilisation in high and medium care prior to their KMC. Therefore when data was collected, no infant was found to have received KMC in isolation and all had been exposed to some length of CC. This confirms Bergman's (2003) report that there is still currently a large reliance on incubator care for premature infants and that

KMC is still not often utilised with very low birth weight babies.[23,46] As a result, the two groups for this study had to be adjusted to premature infants that were between 7-12 months who had been admitted to the low care KMC ward, where KMC is practiced for twenty-four hours a day and mothers are involved in a fulltime KMC programme (KMC group) and those who remained in the high and medium care wards with minimal exposure to KMC at CHB Hospital (CC group). It was assumed that infants admitted to the low care KMC ward had undergone substantially longer periods of KMC than infants who were only admitted to the high and medium care wards, where CC in incubators is mainly used. This was a limitation of the study, as the benefits of the two methods of care could therefore not be considered in isolation to fully analyse a particular method's influence on sensory processing.

The proposed number of participants for this study was 50. There were to be 25 infants in the CC group and 25 infants in the KMC group. On completion of the data collection there were 48 participants in total, with 34 infants in the KMC group and 14 in the CC group. Initially, as noted above, it was hoped that there would be an equal number of infants in each group that could be matched. The group size difference may be due to the fact that the KMC practice is highly promoted at CHB Hospital and where bed space permits, all mothers with infants that meet the criteria are transferred to the low care KMC ward for a period of time. Another factor that influenced the group size was the frequency at which the various clinics were held. The Neonatal Follow-Up Clinic is held once weekly and this is where the infants from the CC group are followed up. The KMC Follow-Up Clinic on the other hand is run twice a week, so it was easier to access a greater number of infants that had been admitted to the low care KMC ward. As a result, the number of infants that could be recruited in seven months for the CC group was quite small (n=14) and could have resulted in a Type II measurement error. The type of sampling used and the sample size may have influenced both the external validity of the study and its generality, as well as the internal validity in terms of the significance of the results and emergence of trends.

Another limitation was that the length of KMC and CC care could not be included as a variable in this study, as this was not documented in the outpatient file and caregivers could not report accurately on this. The researcher therefore decided to omit this aspect from the study, as it was felt that the validity of the research could have been compromised if it was included. In most cases there was only a date of admission and discharge and no documentation surrounding days spent in ICU or incubation. In future this would be important to analyse, as the length that an infant is exposed to either CC or KMC is thought to have an influence on their sensory processing at a later stage of development. It is recommended that the neonatology team include the length and type of care that the infant receives in the outpatient files or RTHC as part of their documentation on discharge, as this will be necessary if further research is to be conducted in this field.

Another factor that needs to be considered is that the KMC practice is encouraged in all neonatal wards at CHB Hospital. It is therefore possible that infants from the CC group may have been exposed to intermittent KMC for a few hours each day as a complement to incubation. This was difficult to report on as caregivers were unable to state the frequency or the length of time that they had practiced KMC, and this was not documented in their outpatient files or RTHC's.

5.4 DEMOGRAPHICS AND MEDICAL INFORMATION OF INFANTS WHO RECEIVED DIFFERENT METHODS OF NEONATAL CARE

The demographics of the caregivers from the KMC and CC groups were compared to ascertain whether they differed at all. The two groups of caregivers were found to be homogeneous in terms of gender, age, language, education, employment, marital status and income bracket. They were only found to differ significantly in the number of children they had borne. The majority of caregivers from the KMC group had their first child participating in the study, whereas in the CC group caregivers already had at least one other child (Appendix I Table 4).

It is possible that the infants in this study that were in the CC group may have undergone this care due to limited availability of their caregivers to be admitted with them into the low care KMC ward for the 24 hour programme because more of these caregivers already had other children at home and more of them were employed. Mothers are given the option to be admitted to the low care KMC ward and on the grounds of these socioeconomic factors discussed above, it is possible that these infants may have been selected for CC rather than KMC, as the caregivers may not have been able to spend up to a month in hospital with their infant.

According to Dunn (2002), her Infant/Toddler Sensory Profile shows that infants in families with more than three children in the house tend to present with a lower amount of sensory seeking behaviours.[10] The CC group was found to have a higher percentage of caregivers who had borne four children and also a higher percentage with more than three children living in their homes (Appendix I Table 4 & 5). On analysis of the distribution of quadrant scores for each group, the CC group did have a higher percentage of infants (28.57%) falling into the PD "*less than others*" category for quadrant 2 (sensation seeking) when compared to the KMC group that had 17.64% falling into the PD and DD "*less than others*" categories, possibly indicating a lower amount of seeking as suggested by Dunn (Table 4.15).[10]

A comparison of the demographics of the two groups of infants who received different methods of care was conducted to detect any differences. The groups of infants were found to be similar in terms of average gestation, birth order and amount of children living in the household, so were therefore deemed comparable (Appendix I Table 5). The two groups were found to differ significantly in terms of gender however, with a much higher percentage of males falling in the CC group (Table 4.11). Kirchengast and Hartmann (2009) report that it has been well documented that males are more likely to be born prematurely, show higher mortality and postnatal complications, and are more at risk for respiratory complications and infectious diseases than females. They state that premature boys are generally less stable than girls after birth.[28] This suggests that males are more vulnerable and therefore require more critical care and stabilisation, which may have accounted for the high percentage of male infants in the CC group.

The medical information of the infants was compared to establish if they differed for the two groups. No significant difference was found for average length of hospital stay, average birth weight, average discharge weight, other care received and therapy received, so the groups were considered homogeneous for these variables (Appendix I Table 6). The only aspect that differed significantly between the two groups was the ICU admission, which was much higher for infants in the CC group. This group also had higher percentages of infants requiring supplemental oxygen and ventilation (Table 4.12). This could indicate that infants in this study who were more critical at birth had undergone CC within the ICU[24] and that the less critical infants had been sent to the low care KMC ward as soon as they were stable. The literature emphasises that early initiation of KMC is a key feature and that an infant is stabilised earlier if the KMC process is commenced early.[21,46] It was therefore felt that the effectiveness of the KMC received at CHB Hospital may have been compromised by the fact that all infants were initially exposed to CC, and as a result the KMC process, as described in the literature, was implemented later after stabilisation and not earlier as is encouraged.

Of the infants in the KMC group, 76.47% did not access any therapy at CHB Hospital. This was much higher than the CC group (Table 4.12). This result may have been due to the fact that infants from the KMC group are followed up at the KMC Follow-Up Clinic, where there is no permanent therapy team in place. If infants are found to have difficulties at this clinic, they are then referred to the appropriate therapy or sent to the Neonatal Follow-Up Clinic for further management. There is a dedicated Allied Medical Discipline team functioning at the weekly Neonatal Follow-Up Clinic where infants from the CC group are followed-up and as a result, these caregivers and infants have access to physiotherapy, occupational therapy and speech and hearing therapy at the clinic.

It must be noted that the record keeping at government hospitals proved to be a limitation in this study, as records are not accurate and comprehensive enough to conduct rigorous testing and research on. In this study outpatient files often contained insufficient and incomplete information, which made data collection difficult at times. The length of care could not be included as a variable in this study due to inadequate records.

A comparison of the Sensory Profiles for the two groups of infants that received different methods of care was conducted. Both the sensory processing sections and the quadrant sections were compared with the scores in relation to typical performance and to ascertain if there were any differences or emerging trends in the Sensory Profiles of these two groups of premature infants.

5.5 SENSORY PROFILES OF INFANTS WHO RECEIVED DIFFERENT METHODS OF NEONATAL CARE

The Sensory Profiles of the infants in the KMC and CC groups were then further investigated. Both the sensory processing sections and the quadrant sections were compared with the scores in relation to typical performance and to ascertain if there were any differences or emerging trends in the Sensory Profiles of these two groups. Analysis of these Sensory Profiles revealed only slight variations.

On analysis of auditory processing, the CC group was found to have their mean score and highest percentage (57.14%) of infants falling into the PD "*more than others*" category. The KMC group had a mean score that fell just within the typical range but half of the infants fell in the PD "*more than others*" category. For visual processing, the mean score for the CC group fell into the PD "*more than others*" category but the KMC group scored just within the typical range. When looking at the percentage of infants scoring within each category, half of the KMC group scored in the PD "*more than others*" category. A higher percentage (42.86%) of infants from the CC group scored in the typical range, though the remainder of the infants distributed equally in the PD and DD "*more than others*" categories (Table 4.13 & 4.14).

Feldman (2004) and Sizun (2004) report that CC often takes place in a NICU where the infant is bombarded with sensory stimuli, such as noise, light and exposure to pain and the infant's immature nervous system has difficulty processing or warding off this stimulation.[24,41,48] This exposure to over stimulation at this early stage of development has been reported to cause behavioural and physiological disorganisation.[41] A higher percentage of the infants from the CC group were exposed to a prolonged period in the NICU environment and this may be an explanation of why this group of infants displayed slightly more sensitivity to auditory stimuli.

Noise is said to be extremely arousing for preterm infants in the NICU. Infants can become agitated and as a result have increased crying, with decreased oxygenation, changes in heart rate and blood pressure. Noise has been shown to interrupt sleep and can influence growth.[48] According to Graven (200) long-term difficulties in auditory processing have been associated with infants that spend time in NICU.[48]

Other than noise, concern has also been expressed about the exposure of immature infants to frequent light in the NICU through bright lights, phototherapy, heat lamps, procedure lights and even sunlight. This increased light intensity has been shown to cause an increase in heart and breathing rates in preterm infants in the NICU.[48] Fielder and Moseley (2000) state that premature infants have thin eyelids and are unable to protect themselves from room light until after 30 weeks when they can close their eyes tightly.[48] Another factor to consider is how exposure to continuous light affects circadian rhythms. It has been suggested that the preterm infant is responsive to light very early (25-28 weeks) and that cycling light in the NICU rather than patching eyes for total darkness has been linked with improved weight gain for these preterm infants.[48] Both groups had over half of their infants scoring in the atypical range for visual processing, even though the mean score for the KMC group was more typical than the CC group, possibly indicating an effect of light exposure during the time spent in high and medium care for both groups (Table 4.13 & 4.14).

Research shows that when newborn infants are separated from their mothers, as in CC, they display "protest-despair", which presents itself as increased crying and protest to return to the mother. This process is sympathetically driven and results in separation stress.[4,5,23] Maternal proximity has also been shown to play a crucial role in the regulation of arousal levels, attention and learning.[24] It must be noted that all infants in this study underwent a period of CC in high and medium care, which highlights the fact that these infants were possibly predisposed to sensory modulation difficulties as a result of this separation from the mother, as the neurological processes discussed above are proposed as underlying the processing of sensory input. It is therefore suggested that KMC be promoted as the preferred method of care for premature infants, on the grounds that "protest-despair" could potentially place infants at risk for later sensory processing and modulation difficulties. Kangaroo mother care has been shown to provide a buffer against over stimulation[21], as the head rests on the mother's chest and the infant is sheltered from excess stimuli leading to reduced stress levels.[22] Though it must be noted that half of the infants from the KMC group still scored in the PD "*more than others*" category for visual and auditory processing, possibly due to prior exposure to some length of CC in the NICU during their stabilisation process (Table 4.14).

The only sensory processing section that displayed a statistically significant difference between the two groups was tactile processing. Even though the scores differed significantly for tactile processing, the mean scores for both groups fell into the PD "*more than others*" category (Table 4.13). This indicates that these infants are more responsive to a stimulus that touches the skin than their peers.[10] There was a much higher percentage of infants (64.29%) in the CC group who scored in the typical range for tactile processing compared to the 29.41% of the KMC group (Table 4.14). The researcher felt that this was an unexpected result, as KMC has been reported to have a number of benefits on the infant's neurophysiological processes and it was thought that the group of infants who received intensive KMC in the low care KMC ward would possibly have had more typical tactile processing scores.

A number of reasons were proposed as possibly leading to this variance in tactile processing scores. A Type II measurement error may have resulted from the CC group being quite small (n=14), which could have led to these unexpected tactile processing scores. The sample size may have influenced both the external validity of the study and its generality, as well as the internal validity in terms of the significance of the results and emergence of trends. As discussed later in section 5.6, the Cronbach's alpha score for the tactile processing section in this study was lower than the score obtained in the reliability and validity studies conducted on the Sensory Profile. This could indicate poor comprehension of items within this tactile processing section by this sample population, which could have further influenced the validity of the results.

The tactile processing results of the KMC group are considered reliable, as the sample size was adequate to meet the level of significance. It must however be stated that the results of this study differ remarkably from other literature published about the KMC practice and its benefits. All 34 infants who were admitted to the low care KMC ward in this study may have undergone some period of CC during their stabilisation in high and medium care, which could have influenced these tactile scores. It is also thought that if these infants had received KMC in isolation, the scores for tactile processing might have potentially been different, as research has shown that skin-to-skin contact is associated with less behavioural and emotional problems, resulting in greater security of attachment with the primary caregiver.[31] According to Weiss (2005), research suggests that a preterm infant's exposure to stimulating, frequent and supplemental touch in the first few months, as in KMC, may improve the infant's neuropsychological outcomes and both mental and psychomotor abilities.[31] On the other hand Lynam (2003) states that touch in the NICU, where CC often takes place, is usually related to medical care rather than social nurturing.[48] The infants from the KMC group were monitored at the KMC Follow-Up Clinic as stated before, where there is no permanent therapy team in place. As a result, less of these infants who underwent KMC in this study received therapy, which could have further influenced the outcomes of this research (Table 4.12).

Both groups of infants displayed mean scores that fell in the typical performance range for vestibular processing and oral sensory processing (Table 4.13). The largest percentage of infants from both groups fell in the typical performance range for these two sensory processing sections (Table 4.14). There was therefore no difference between the two groups in behavioural responses to incoming vestibular and oral sensory stimuli, which was the same as the findings discussed for the total sample of infants.

Overall on analysis of the sensory processing sections, the average infant from the KMC group displayed typical performance with only tactile processing being atypical, where the average infant from the CC group tended to be slightly over responsive to auditory and visual stimuli as well as tactile input.

On investigation of the quadrant summary, there was no significant difference detected between the scores of the two groups of infants on all four quadrants. Both groups had mean scores that fell in the atypical PD and DD "*more than others*" categories for quadrant 1 (low registration), 3 (sensory sensitivity) and 4 (sensation avoiding) (Table 4.13). Both groups had higher percentages of infants falling into the PD and DD "*more than others*" categories for quadrant 1 (low registration) and 3 (sensory sensitivity) (Table 4.15). For quadrant 4 (sensation avoiding), a higher percentage of infants in the CC group scored in the typical range than the KMC group (Table 4.15). The KMC group displayed slightly higher levels of active avoidance, indicated by the 26.47% of infants that scored in the PD and DD "*more than others*" categories respectively (Table 4.15).

Quadrant 2 (sensation seeking) had higher percentages of both groups falling into the typical range, indicating typical sensory seeking behaviour for infants aged 7-12 months (Table 4.15). The mean scores for both groups also fell within the typical performance range for this quadrant (Table 4.13). There was therefore no difference between the two groups in sensory seeking behaviour, which was the same as the findings discussed for the total sample of infants.

In terms of the low threshold score, half of the KMC group scored in the DD "*more than others*" category and all scores were found to be relevant (Table 4.15). For the CC group 28.57% of the infants scored in the DD "*more than others*" category and all scores were found to be relevant (Table 4.15). Both groups had mean low threshold scores that fell in the PD "*more than others*" category (Table 4.13).

It must be noted that the Sensory Profile was designed and standardised in the United Sates of America, thus it was deemed necessary to investigate the reliability and validity of this test in South Africa in the next section, particularly with the study sample in Soweto, to see if this may have impacted on the tactile scores obtained.

5.6 SENSORY PROFILE AND RELIABILITY IN THIS CONTEXT

The Infant/Toddler Sensory Profile was then further analysed to ascertain its reliability in the South African context, particularly this study sample in Soweto, Gauteng. An item analysis was performed with consideration of Cronbach's alpha scores to see whether this test was understood by the caregivers and reliable for this sample. It must be noted that the Sensory Profile was in English and was not translated into any African languages for the purpose of this study. This was a limitation for the study as only 8.33% of the caregivers spoke English as a first language, though the researcher used a Zulu/Sotho research assistant to assist with translation and explanation of difficult items where required in an attempt to overcome this limitation.

It must be noted that most caregivers who participated in this study were able to at least speak and read basic English even though it was not their first language. Some were able to complete the Sensory Profile independently and others required translation of only certain items that they had difficulty comprehending.

When reviewing the internal consistency of items within each group, it was found that the Cronbach's alpha coefficient values were similar, if not better, for most sensory processing sections than those obtained in the reliability and validity studies conducted on the Infant/Toddler Sensory Profile as reported by Dunn (Table 4.16).[10] This indicated that the Sensory Profile was mostly reliable when used with this population. The only section where the Cronbach's alpha scores differed substantially was tactile processing. The Cronbach's alpha score for this section in this study was particularly low (0.5) compared to the Cronbach's alpha score obtained in the reliability and validity studies conducted on the Sensory Profile, which was 0.71 (Table 4.16).[10] This could indicate poor comprehension of items within this section by this sample population, which could have influenced the validity of the results. The researcher therefore proposes that the statistically significant difference in tactile processing scores between the two groups of infants should be interpreted with caution, as this was the only section that displayed lower internal consistency compared to the original Sensory Profile studies conducted.

On analysis of the tactile processing section, items 21, 27, 30, 31 and 35 were shown to influence the overall alpha coefficient, which was low for this section. On further investigation, these items were noted to contain a number of words that frequently came up during the research as difficult words for the caregivers to understand. These were “resists”, “anxious”, “agitated”, “cuddled” and “textures”. The caregivers seemed to have difficulty understanding these English words and required translation of items containing these words into Zulu/Sotho by the research assistant. Item 27 in particular created some confusion amongst the caregivers, as the caregivers reported that they do not place their child on rough or cold surfaces. They reported that in the African culture, keeping the infant warm is very important and the baby should be protected and not experience any pain or discomfort. In many homes the caregivers reported that they did not have grass areas/lawns for the infants to crawl on, so this could result in future sensitivity or avoidance by the infants when exposed to these unfamiliar textures. The researcher felt that these factors could have influenced the overall tactile processing score and reliability of this section for the sample population.

Item 30 of the tactile processing section was the only item that showed a statistically significant difference between the two groups in terms of response on the Sensory Profile. A score of **1** correlates with **almost always** and was higher in the CC group. This indicates that the child nearly always becomes anxious when placed on the different surfaces such as grass, carpet or tile, which indicates over responsiveness or sensitivity to these tactile stimuli. The group that received both KMC and CC was found to have higher than average **4** and **5** scores, which indicates that the child **seldom** or **almost never** becomes anxious when placed on the different surfaces mentioned above, displaying under responsiveness to these tactile stimuli. Overall there was a wide range of scores for both groups; it was therefore difficult to isolate a specific trend in behaviour on this particular item of the Sensory Profile and the researcher felt that this item might have had such a varied response due to poor comprehension by the caregivers (Figure 4.5).

In other sections, some questions on sensory processing proved too difficult for the caregivers to answer for various reasons. The inclusion of these questions may have also affected the validity of the measuring instrument. In the visual processing section, some caregivers had difficulty with item 18 and 19. These questions both involve the child looking in a mirror. It was reported by caregivers that in certain African cultures a child is not encouraged to look in the mirror, as it is believed that the infant could develop a squint as a result. The researcher felt that this could skew the results on these particular items as caregivers tended to report the frequency of this behaviour as **almost never**, which could have influenced the overall visual processing score.

Under the vestibular processing section, items 39 and 40 were shown to influence the overall Cronbach's alpha value for this section. For item 39, the researcher felt that the word "diapers", which is an American term for nappies, was confusing to the sample population who were mostly unfamiliar with this term. This word therefore required frequent clarification with the caregivers. For item 40, the word "resists" appeared again and this was a difficult word for the caregivers to understand as discussed previously.

The oral sensory processing section's overall Cronbach's alpha value was influenced by item 45 and 46. Item 45 states, "My child refuses all but a few food choices", which links once again to the previous comment on the influence of African culture, as caregivers expressed that fussiness over food is not a great concern with infants. Certain caregivers were unable to report on item 46 of the oral sensory processing section, as many infants in the study did not have any teeth yet, as premature infants often get their teeth slightly later than full term infants. It must be noted that in this sample population caregivers had not always started brushing their infants' teeth even when the infants had some teeth present. This may have been due to socioeconomic reasons, which in the context of this study also limited the food choices of these infants as stated above. The researcher felt that this could have influenced the overall oral sensory processing score, as an average of the scores within this section had to be taken when this item was omitted by certain caregivers.

5.7 SUMMARY

50% of the total sample of infants participating in this study were found to be low threshold infants, with scores on quadrant 3 (sensory sensitive) and 4 (sensation avoiding) both falling out of the typical range in the PD and DD "*more than others*" categories (Figure 4.4). Of these low threshold infants, 79.17% also scored in the PD and DD "*more than others*" categories for quadrant 1 (low registration), which could indicate *shut down* for these infants, as discussed previously. Furthermore, 27.08% of the total sample of infants, who were not found to be low threshold infants, scored in the atypical range for quadrant 1 (low registration) (Figure 4.2). For quadrant 2 (sensation seeking), 39.58% of the total sample of infants scored in the atypical range (Figure 4.3). These results show that many infants in this study sample displayed behaviours indicative of a sensory processing dysfunction, though further consult and follow-up with a SI therapist would be necessary to make a definite diagnosis. 50% of the total sample of infants were described as low threshold infants showing sensitivity to auditory, visual and tactile stimuli in particular, which confirms the current literature that reports that premature infants are predisposed to sensory processing dysfunction and become easily over aroused, having difficulty with self-regulation.[16,19]

On comparison of the two methods of care, no significant differences were noted for sensory processing of the two groups of infants; only the tactile processing section showed a statistically significant difference, with the CC group scoring closer to the typical range. Kangaroo mother care has been shown to reduce both mother and infant stress levels, improve autonomic stability, encourage greater attachment with the mother, improve regulation of arousal levels and prevents over stimulation of the infant.[3,4,21,22] From a SI perspective, the researcher thought that these factors could possibly play a positive role in the infant's sensory processing, as sensory modulation deficits have been linked to autonomic nervous system dysfunction and difficulties with achieving homeostasis and self-regulation.[2] Field and colleagues (1998) have also shown that premature infants receiving controlled tactile and movement stimulation gained weight quicker, had shorter hospital admissions and had better developmental outcomes than matched controls[16], as is the case in the KMC practice.

The literature indicates that KMC results in greater autonomic stability, better neurophysiological outcomes due to the affective, supplemental touch associated with the practice and better regulation of arousal, which the researcher thought would have had an influence on the infants' sensory processing. On evaluation of the results, the practice of KMC in this study was not found to be beneficial to sensory processing, though a number of Type II measurement errors may have influenced this result. The result could be due to the following reasons: (1) that infants from the KMC group may have been exposed to a period of incubation during their stabilisation in high or medium care, (2) that the duration of the KMC practice was too short, (3) that the KMC practice was discontinued on reaching home and (4) that the KMC group infants had smaller birth and discharge weights. Most trial studies with KMC have focused on stable low and very low birth weight infants and more trials need to be conducted on the efficacy of KMC with extremely low birth weight infants.[46] A number of infants in this study fell into the extremely low birth weight category, so it is difficult to ascertain how the infants were able to cope with the amount of handling.

It is also important to remember that in African culture, infants are mostly transported on the mother's back, which exposes them to constant rhythmical movement and deep pressure, which tends to have a calming and organising effect on the nervous system. Walker and Menahem (1994) in their study report that literature on cross cultural infant rearing indicates reduced fussiness and crying with longer periods of alert arousal and in infants carried in close contact with the mother, usually on the back.[49] Canadian babies carried for four hours a day from four months, providing contact with the mother, cried and fussed 43% less than control babies.[50] Most of the infants from both groups were carried on their caregiver's back, so infants from the CC group were also exposed to regular caregiver carrying, which could possibly have influenced results.

There is also a developmentally supportive care programme in place at CHB Hospital's neonatal unit, so mothers are taught the importance of handling and positioning infants at risk to encourage normal development, which could be improving the outcomes for the infants receiving CC.[53] From the results of this study it was therefore shown that the different methods of neonatal care did not make a significant difference to the infant's overall sensory processing because there is no clear separation of CC and KMC at CHB Hospital, with all infants possibly receiving a combination of these two cares in the high and medium care wards.

The only area that was found to differ significantly was tactile processing and it is in the researcher's opinion that this may have been influenced by a number of factors discussed above, such as low internal consistency of items in this section and poor comprehension of certain items within the tactile processing section by caregivers. As a result, this difference in tactile processing between the two groups is to be interpreted with caution and should in future be conducted on a sample that received both methods of care in isolation and with a larger sample size.

CHAPTER 6 - CONCLUSION

The purpose of this study is to investigate infants born prematurely at CHB Hospital and how this might have influenced their ability to process sensory information at a later stage of development. This was assessed using the standardised Infant/Toddler Sensory Profile focussing on ages 7-12 months (uncorrected). Another purpose of this study is to compare the Sensory Profiles of infants who received different methods of neonatal care. This study aims to provide CHB Hospital, which has a high number of infants born daily and limited resources available, with valuable management data for the development of future neonatal care programmes. The study ascertains the validity and reliability of the Sensory Profile for the South African sample used in this study.

On completion of this research, it was concluded that 50% of the premature infants in this study were found to be low threshold infants, over responsive to sensory stimuli, particularly auditory, visual and tactile stimuli, which is supported by some of the existing literature.[10,16,19] This indicated an atypical score for quadrant 3 (sensory sensitive) and 4 (sensation avoiding) for half of these premature infants. Of these low threshold infants, 79.17% also scored in the PD and DD "*more than others*" categories for quadrant 1 (low registration), which could indicate *shut down* for these infants in response to sensory overload as discussed previously. A further 27.08% of the total sample that were not low threshold infants also scored in the atypical range for quadrant 1 (low registration). Overall the results from this study indicate that these premature infants display at-risk patterns related sensory processing, though further follow-up and consult is required to make a definite diagnosis.

The sample of 48 premature infants in this study were not found to be sensation seeking, as 60.42% fell in the typical performance range for this quadrant. For quadrant 2 (sensation seeking), 18.75% of the premature infants scored in the PD "*more than others*" category, 20.83% scored in the PD and DD "*less than others*" categories. These findings are contrary to those of Case-Smith et al (1998) who found premature infants in their sample to display higher amounts of sensory seeking behaviours.[15]

It must be noted that there are varying reports on the presence of sensory processing difficulties in the age group of the study sample, with Dunn (2002) reporting that the effects of prematurity tend to fade in the age band 7-36 months and with Santman Weiner et al (1996) indicating that the presence of sensory processing problems exists across the age band of 7-18 months (corrected age).[10,25] Caprio et al (1998) report that there is a difference in sensory functioning between full-term and premature infants in the age band of 4-18 months.[32]

In the SI literature reviewed for this research, certain researchers corrected for an infant's prematurity[25,33] and others did not[32] leading to inconsistency. In some studies there was no reflection as to whether prematurity was corrected for or not, which could potentially influence the comparison of results between different studies conducted. There is a lack of universality in the assessment tools used in SI infant research as some studies used the Infant/Toddler Sensory Profile, while others used the Test of Sensory Function in Infants (TSFI) and both these tests require further clinical studies to standardise them for the preterm infant.[25,32,33] It has been shown that it is insufficient to make a diagnosis based on test scores alone and that clinical consult and follow-up measures need to be included in future studies to confirm a diagnosis of sensory processing dysfunction. It is therefore difficult to include the prevalence of sensory processing difficulties in specific infant groups, such as preterms, as test scores alone do not indicate the presence of dysfunction.

On comparison of the different methods of neonatal care and how this impacts on sensory processing, the KMC group and CC group were not found to differ significantly on both the sensory processing areas and quadrants of the Sensory Profile. The only area of significant difference between these two groups was tactile processing with both groups displaying sensitivity to tactile input. There was a higher percentage of infants in the CC group who scored in the typical range for tactile processing. This was an unexpected result as the researcher thought that the infants who had received KMC would possibly have had more typical tactile processing scores, as literature indicates that KMC results in greater autonomic stability, better neurophysiological outcomes due to the affective, supplemental touch associated with the practice and better regulation of arousal, which the researcher thought would have had an influence on the infants' sensory processing.[4,19,31,46]

The researcher proposed that this unexpected tactile processing result may have been further influenced by the following reasons: (1) that infants from the KMC group may have been exposed to a period of incubation during their stabilisation in high or medium care, (2) that the duration of the KMC practice was too short, (3) that the KMC practice was discontinued on reaching home, (4) that the KMC group infants had smaller birth and discharge weights and (5) that infants from both groups were exposed to caregiver carrying. Another factor that could have influenced this result was poor comprehension of items within this section, as this was the only sensory processing section that displayed poor reliability when compared to the Cronbach's alpha scores obtained by Dunn in her reliability and validity studies.[10] Throughout the test a number of words reappeared as difficult for this sample population to understand, these words therefore required frequent translation by the research assistant. As a result, this difference in tactile processing between the two groups is to be interpreted with caution and should in future be conducted on a sample that received both methods of care in isolation and with a larger sample size.

The other sensory processing sections of the Infant/Toddler Sensory Profile were found to be reliable for this sample population as the Cronbach's alpha scores were similar, if not better, than those obtained in the reliability and validity studies originally conducted on the Sensory Profile.

Other limitations of this study include the sample size of the CC group (n=14), which was smaller than initially proposed in the methodology and this could have led to a Type II measurement error. The length of care was not documented in the hospital records and could therefore not be included as a variable in this research study. Another factor that needs to be considered is that the KMC practice is encouraged in all neonatal wards at CHB Hospital. It is therefore possible that infants from the CC group may have been exposed to intermittent KMC for a few hours each day as a complement to incubation in high and medium care. This was a limitation of the study, as the benefits of the two methods of care could therefore not be considered in isolation to fully analyse a particular method's influence on an infant's sensory processing. Inadequate record keeping at CHB Hospital also affected the results.

6.1 RECOMMENDATIONS

It must be noted that 70.83% of the premature infants in this study did not receive any therapy even though they had complications such as developmental delay. The KMC group had infants that were followed up mainly at the KMC Follow-Up Clinic and 76.47% of these infants did not receive any therapy, possibly indicating the need for the Allied Medical Disciplines to partner with this clinic in identifying developmental delays. At present there is no consistent team of therapists that attends the KMC Follow-Up Clinic, and as a result a high number of these infants are not receiving the necessary intervention that they require. Infants from the CC group are followed up at the Neonatal Follow-Up Clinic where there is a dedicated Allied Medical Discipline partnership with the neonatologists and as a result 42.86% of this group were able to access the necessary therapy. The researcher therefore suggests that the Allied Medical Disciplines should implement screening procedures at the KMC Follow-Up Clinics to detect infants that require intervention. If possible home programmes could be given to caregivers at the clinic, or if any infants require more specialised treatment they should be referred to the SI trained occupational therapist at CHB Hospital for assessment and treatment.

The researcher feels that the developmentally supportive programme that is currently in place in CHB Hospital's neonatal wards needs to be continued to encourage an optimal sensory environment for these premature neonates, who have been shown in this study to be at risk for sensory processing and modulation difficulties. The programme is based on SI principles such as exposing infants to calming inputs such as deep pressure, proprioception and warmth. The programme looks at the handling and positioning of infants at risk to encourage normal development and to facilitate soothing and self-regulation, thereby improving their modulation of behaviour. The occupational therapists at CHB Hospital need to regularly review and monitor the programme to ascertain whether the caregivers and nursing staff are following the programme correctly and regularly to achieve maximal benefits for all CC infants in high and medium care, as it appears to be followed unsystematically at times.

It is suggested that the caregivers practicing KMC should be given clear guidelines of how to continue the practice at home after discharge. The caregivers are usually followed up monthly after discharge but this may need to be done on a weekly basis to monitor whether caregivers are being compliant with the KMC practice at home as infants are discharged when they still fall into the low birth weight category.

In conclusion, it has been shown that there is great need for a sensory processing test to be adapted for use with the South African population, with simple terminology and English words commonly used in the South African context. There is also a need for the Infant/Toddler Sensory Profile to be translated for use as an assessment tool in South Africa but this is a significant challenge with the wide range of African languages spoken in different parts of this country.

The researcher therefore proposes that further research needs to be conducted in this area with a larger sample size and matching of the two groups of infants. Research would need to be conducted on a group of infants that are transferred to the low care KMC ward as soon as possible so that they receive maximum benefits from the KMC practice. The inclusion of the duration of each method of care may be beneficial in future studies to ascertain whether length of care influences sensory processing scores in any way. The current record keeping system in outpatient files would need to be improved so that this could be included as a variable in future studies.

More scientific research is needed in the SI field of sensory processing, as other than autonomic nervous system links the physiological processes that underlie sensory processing remain hypothetical. On analysis of the proposed neurological basis of sensory modulation, there seems to be possible connections to neurophysiological difficulties that preterm infants experience, placing them at risk for sensory processing difficulties. There is also a need for SI terminology to be universally consistent to avoid confusion between researchers. The findings to date about sensory processing in premature infants are not considered definitive until follow-up studies are conducted on SI functioning in the preschool and school years.

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APPENDICES

A	Request for permission to conduct research
B	Response form
C1	Subject information sheet
C2	Subject informed consent
D	Cover sheet
E	Background information questionnaire
F1	Infant/Toddler Sensory Profile
F2	Sensory Profile summary score sheet
G	Ethical clearance certificate
H	Letter of thanks
I	Data and statistics

Occupational Therapy

School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

To Whom It May Concern,

I am an Occupational Therapist currently working on my M Sc (OT) degree at the University of the Witwatersrand and am required to complete a research report as part of my qualification. The research that I would like to undertake is an investigation into the effects of premature neonatal care on the sensory processing abilities of infants from seven-12 months.

In order to conduct this research, the involvement of some of your Occupational Therapists and patients at CH Baragwanath hospital will be required. The research will involve weekly screening of your Neonatal and KMC Follow-Up Clinics for suitable subjects. The subjects will be caregivers of infants between 7-12 months of age, who were born prematurely and underwent neonatal care at your institution. The caregivers, should they agree to participate in the study, will be asked to complete a self-administered background information questionnaire and Infant/Toddler Sensory Profile. This information will be used to draw comparisons between the sensory profiles of infants that underwent different methods of premature neonatal care at your institution.

The subjects will be asked to sign consent to obtain/confirm medical information and neonatal care from their infant's outpatient hospital file and Road-to-Health chart. Their participation in the research is voluntary and they are under no obligation to partake in the study. If they do not wish to participate in this study, this will not affect the quality of therapy or care that they receive at your hospital.

Occupational Therapy

School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

I trust that you will look favourably on this research for the further development of understanding in this area of neonatal care and sensory processing. I trust that your hospital will afford me the opportunity to use patients from your Neonatal and KMC Follow-Up Clinics in the above-mentioned research. Thank you.

Yours sincerely,

Shirley Tudor

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THERAPEUTIC Sciences

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

Occupational Therapy

School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

RESPONSE FORM

I hereby give consent for Shirley Tudor, a student at the University of the Witwatersrand, to conduct her research at CH Baragwanath hospital in fulfillment of the requirements for her research report for her M Sc (OT) degree.

I have read the attached information sheet and understand the conditions therein.

Yours sincerely,

Name of consenting authority:

Premila Naik

Position held by consenting authority:

SCE

Signature of consenting authority:

PNaik

Name of hospital:

CHBH.

THERAPEUTIC Sciences

Occupational Therapy

School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

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SUBJECT INFORMATION SHEET

Hello,

My name is Shirley Tudor and I am an Occupational Therapist and student from the University of the Witwatersrand. The title of my research project is: THE SENSORY PROFILES OF INFANTS WHO RECEIVED DIFFERENT METHODS OF PREMATURE NEONATAL CARE.

A baby that is born early (before 37 weeks) is called premature. Premature babies find it hard to keep their body temperature warm, so they have to be cared for in an incubator or through kangaroo mother care, which is when the baby is kept warm by being tied to the mother's chest. Your baby underwent one of these methods of care at Chris Hani Baragwanath Hospital when they were born at 37 weeks or earlier, and this is why you are invited to participate in this study.

Sensory processing is the way that the body's nervous system understands all the information that it gets from touching, smelling, seeing, hearing, tasting and moving the head and body. The body then uses all this information and organises it so that a person can do everyday activities. Some children can have problems with understanding and processing this information coming in from their senses. Premature babies can have sensory processing problems as well. This research is important, as little information is known about how different types of premature care can affect a baby's sensory processing when they get older.

Should you volunteer to take part in this study, you will be asked to fill in two questionnaires at Chris Hani Baragwanath Hospital's Neonatal or KMC Follow-Up Clinics while you are waiting to see the doctor. You will need to complete a background information questionnaire and you will be asked to answer some questions on a questionnaire called the Infant/Toddler Sensory Profile, the researcher/research assistant will be available if you need help filling them in.

THERAPEUTIC Sciences

Occupational Therapy

School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

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The Sensory Profile has 48 questions that you, the caregiver, will need to answer. This should take approximately 20-30 minutes to finish; someone will be able to translate into Zulu/Sotho if you do not understand any questions.

Feel free to ask for feedback and information about the study at any stage. If it is found that your child has a problem with sensory processing, you will be given names and numbers of therapists so that your child can get help, otherwise a follow-up date for a full assessment can be made with a therapist in the Paediatric Occupational Therapy Department at this hospital.

You will also be asked to give consent for information about the neonatal care that your child received to be taken from their outpatient hospital file and Road-to-Health chart. Your participation in this research is voluntary and you do not have to take part in this project. If you choose not to participate, this will not affect the quality of therapy or care that you receive at this hospital. When you answer the questionnaires, you will be given a number to identify you, so that your name will not be known. Your information will be kept private and the information that you give me will be used only for this research project. You are welcome to ask about the results of the study when it is finished.

If you have any queries, you can get more information from myself at the following contact numbers: 084 514 8065/ 011 933 8294. If you are happy to take part in this study, you will now be asked to fill in the questionnaire and Sensory Profile.

Thank you,

Shirley Tudor

THERAPEUTIC Sciences

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

Occupational Therapy

School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

SUBJECT INFORMED CONSENT

I ____________________________ give permission for my child's medical records to be reviewed for the research entitled THE SENSORY PROFILES OF INFANTS WHO RECEIVED DIFFERENT METHODS OF PREMATURE NEONATAL CARE.

Signature ______________________________

Date ______________________________

THERAPEUTIC Sciences

COVER SHEET

Subject Names:

Infant: ____

Caregiver: ____

Subject Number: ____

Date: ____

Contact Number: ____

Address:

____

____

____

____

BACKGROUND INFORMATION QUESTIONNAIRE

(Tick relevant block)

Subject Number _____________

Caregiver information

Age:

16- 20 years	21-25 years	26- 30 years	31- 35 years	36-40 years	41 years onwards

Gender:

Male	Female

Marital Status:

Single	Married	Divorced	Widowed

Home Language:

English	Zulu	Sotho	Afrikaans	Xhosa	Other

Highest Level of Education:

No formal education	Primary School Level	High School Level	Tertiary Education	Informal Training	Other

Employed:

Yes	No

If yes, state occupation.

____

Income bracket:

R0- R1000	R1000- R2000	R2000- R4000	R4000- R6000	R6000- R10 000	R 10 000 +

Number of children:

1	2	3	4	5 or more

Infant information

Date of birth:

____

Age on assessment:

____

Birth Weight:

____

Gender:

Male	Female

Medical History

Born at how many weeks gestation:

____

Neonatal care:

Incubation	Kangaroo mother care

Describe the neonatal care mentioned above and the length of care:

____

____

Date of discharge:

____

Discharge weight:

____

Any other medical treatments:

____

Other complications/ illnesses:

____

Other therapy:

____

Do you have any other problems with your baby?

____

____

____

INFANT/TODDLER SENSORY PROFILE™

Winnie Dunn, Ph.D., OTR, FAOTA
with Debora B. Daniels, M.A., CCC-SLP

Caregiver Questionnaire

7 TO 36 MONTHS

Child's Name: ______________________ Birth Date: ____________ Date: ____________

Completed by: ______________________ Relationship to Child: ______________________

Service Provider's Name: ______________________ Discipline: ______________________

Circle the birth order of your child within the family 1st 2nd 3rd 4th 5th Other__________

Have there been more than 3 children, between the ages of birth–18 years, living in your household during the past 12 months?______________________

INSTRUCTIONS

Please check the box that **best** describes the frequency with which your child does the following behaviors. Please answer all of the statements. If you are unable to comment because you have not observed the behavior or believe that it does not apply to your child, please draw an X through the number for that item. Write any comments at the end of each section.

Use the following key to mark your responses

ALMOST ALWAYS	When presented with the opportunity, your child **almost always** responds in this manner, 90% or more of the time.
FREQUENTLY	When presented with the opportunity, your child **frequently** responds in this manner, about 75% of the time.
OCCASIONALLY	When presented with the opportunity, your child **occasionally** responds in this manner, about 50% of the time.
SELDOM	When presented with the opportunity, your child **seldom** responds in this manner, about 25% of the time.
ALMOST NEVER	When presented with the opportunity, your child **almost never** responds in this manner, 10% or less of the time.

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Item	A. General Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
1	My child's behavior deteriorates when the schedule changes.					
2	My child avoids playing with others.					
3	My child withdraws from situations.					

Note: You do not calculate a Raw Score Total for this section.

Comments

Item	B. Auditory Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
4	I have to speak loudly to get my child's attention.					
5	I have to touch my child to gain attention.					
6	My child enjoys making sounds with his/her mouth.					
7	My child takes a long time to respond, even to familiar voices.					
8	My child startles easily at sound, compared to other children the same age.					
9	My child is distracted and/or has difficulty eating in noisy environments.					
10	My child ignores me when I am talking.					
11	My child tries to escape from noisy environments.					
12	My child finds ways to make noise with toys.					
13	It takes a long time for my child to respond to his/her name when it is called.					
	Section Raw Score Total					

Comments

Item	C. Visual Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
14	My child enjoys looking at moving or spinning objects (for example, ceiling fans, toys with wheels, floor fans).					
15	My child enjoys looking at shiny objects.					
16	My child avoids eye contact with me.					
17	My child refuses to look at books with me.					
18	My child does not recognize self in the mirror.					
19	My child enjoys looking at own reflection in the mirror.					
20	My child prefers fast-paced, brightly colored TV shows.					
	Section Raw Score Total					

Comments

Item		D. Tactile Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
	21	My child resists being held.					
	22	My child becomes agitated when having hair washed.					
	23	My child avoids getting face/nose wiped.					
	24	My child is distressed when having nails trimmed.					
	25	My child resists being cuddled.					
	26	My child is upset by changes in the bath water temperature, from one bath to the next.					
	27	My child avoids contact with rough or cold surfaces (for example, squirms, arches, cries).					
	28	My child becomes very upset if own clothing, hands, and/or face are messy.					
	29	My child gets upset with extreme differences in room temperature (for example, hotter, colder).					
	30	My child becomes anxious when walking or crawling on certain surfaces (for example, grass, sand, carpet, tile).					
	31	My child enjoys playing with food.					
	32	My child seeks opportunities to feel vibrations (for example, stereo speakers, washer, dryer).					
	33	My child bumps into things, seeming to not notice objects in the way.					
	34	My child enjoys splashing during bath time.					
	35	My child uses hands to explore food and other textures.					
		Section Raw Score Total					

Comments

Item		E. Vestibular Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
	36	My child requires more support for sitting than other children the same age (for example, infant seat, pillows, towel roll).					
	37	My child enjoys physical activity (for example, bouncing, being held up high in the air).					
	38	My child enjoys rhythmical activities (for example, swinging, rocking, car rides).					
	39	My child becomes upset when placed on back to change diapers.					
	40	My child resists having head tipped back during bathing.					
	41	My child cries or fusses whenever I try to move him/her.					
		Section Raw Score Total					

Comments

Item	F. Oral Sensory Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
42	My child licks/chews on nonfood objects.					
43	My child mouths objects.					
44	My child is unaware of food or liquid left on lips.					
45	My child refuses all but a few food choices.					
46	My child resists having teeth brushed.					
47	My child refuses to drink from a cup.					
48	My child refuses to try new foods.					
	Section Raw Score Total					

Comments

What do you see as your child's strengths? ______________________________

What are your concerns? ______________________________

STOP HERE IF YOUR CHILD IS 7 TO 36 MONTHS OLD.

ICON KEY
Low Registration
Sensation Seeking
Sensory Sensitivity
Sensation Avoiding

SCORE KEY	
1	Almost Always
2	Frequently
3	Occasionally
4	Seldom
5	Almost Never

APPENDIX F2

INFANT/TODDLER

SENSORY PROFILE™

Winnie Dunn, Ph.D., OTR, FAOTA

Summary Score Sheet

Child's Name: ______________________ Gender: ☐ Male ☐ Female

Questionnaire Completed by: ______________________

Relationship to Child: ______________________

Service Provider's Name: ______________________

Discipline: ______________________

	YEAR	MONTH	DAY
Date Tested			
Date of Birth			
Chronological Age			

The child receives the following service(s)

- ☐ Early Intervention/Preschool Services
- ☐ Occupational Therapy
- ☐ Physical Therapy
- ☐ Speech Therapy
- ☐ Other (please specify) ______________________

Child's condition(s)

- ☐ Mental retardation
- ☐ Down Syndrome
- ☐ Speech or Language Impairment
- ☐ Autism/Pervasive Developmental Disorder (PDD)
- ☐ Developmental Delay
- ☐ Emotional disturbance or serious behavioral difficulties
- ☐ Attention disorder (ADD, ADHD)
- ☐ Visual impairment/Blindness
- ☐ Hearing impairment/Deafness
- ☐ Cerebral Palsy
- ☐ Fragile X
- ☐ Reflux
- ☐ Multiple disabilities
- ☐ Traumatic brain injury
- ☐ Other neurological disorder
- ☐ Other health conditions (e.g., cardiac disorder, asthma)
- ☐ Regulatory disorder
- ☐ Other (please specify): ______________________

Referral concerns and other comments

____

____

____

____

____

____

____

____

7 to 36 Months Summary Score Sheet

Quadrant Grid

Instructions: Transfer from the Caregiver Questionnaire (7 to 36 months) the item raw score that corresponds with each item listed. Add the Raw Score column to get the Quadrant Raw Score Total for each quadrant.

QUADRANT 1	
Low Registration	
Item	Raw Score
4	
5	
7	
10	
13	
16	
18	
33	
36	
44	
47	
Quadrant Raw Score Total	

QUADRANT 2	
Sensation Seeking	
Item	Raw Score
6	
12	
14	
15	
19	
20	
31	
32	
34	
35	
37	
38	
42	
43	
Quadrant Raw Score Total	

QUADRANT 3	
Sensory Sensitivity	
Item	Raw Score
1	
8	
9	
22	
24	
26	
28	
29	
30	
39	
41	
Quadrant Raw Score Total	

QUADRANT 4	
Sensation Avoiding	
Item	Raw Score
2	
3	
11	
17	
21	
23	
25	
27	
40	
45	
46	
48	
Quadrant Raw Score Total	

ICON KEY
Low Registration
Sensation Seeking
Sensory Sensitivity
Sensation Avoiding

Low Threshold (combined quadrant score)

Instructions: Add Sensory Sensitivity and Sensation Avoiding Quadrant Raw Score Totals to get the Low Threshold Raw Score Total

Low Threshold Raw Score Total	____ + ____ = ____

Quadrant Summary

Instructions: Transfer the Quadrant Raw Score Totals from the 7 to 36 months Quadrant Grid to the corresponding Quadrant Raw Score Total box for the appropriate ages. Plot these totals by marking an X in the appropriate classification column (Typical Performance, Probable Difference, Definite Difference)*.

		Less Than Others ←			→ More Than Others	
Quadrant	Quadrant Raw Score Total	Definite Difference	Probable Difference	Typical Performance	Probable Difference	Definite Difference
1. Low Registration (7–36 months)	/55	**	55	54 ---------- 46	45 ---------- 43	42 ---------- 11
2. Sensation Seeking (7–12 months)	/70	70 ---------- 44	43 ---------- 36	35 ---------- 19	18 ---------- 14	**
2. Sensation Seeking (13–18 months)	/70	70 ---------- 46	45 ---------- 38	37 ---------- 20	19 ---------- 14	**
2. Sensation Seeking (19–24 months)	/70	70 ---------- 50	49 ---------- 42	41 ---------- 25	24 ---------- 16	15 ---------- 14
2. Sensation Seeking (25–30 months)	/70	70 ---------- 50	49 ---------- 43	42 ---------- 27	26 ---------- 19	18 ---------- 14
2. Sensation Seeking (31–36 months)	/70	70 ---------- 59	58 ---------- 49	48 ---------- 28	27 ---------- 18	17 ---------- 14
3. Sensory Sensitivity (7–36 months)	/55	**	55 ---------- 53	52 ---------- 41	40 ---------- 36	35 ---------- 11
4. Sensation Avoiding (7–36 months)	/60	**	60 ---------- 57	56 ---------- 45	44 ---------- 39	38 ---------- 12
Low Threshold	**Raw Score Total**	**Note:** This score is only relevant when both Quadrants 3 and 4 are outside the Typical Performance range.				
Low Threshold (7–36 months)	/115	**	115 ---------- 108	107 ---------- 87	86 ---------- 77	76 ---------- 23

*Classifications are based on the performance of children without disabilities ($n = 489$).
**There can be no Definite Difference for this section in this age range.

Sensory Processing Section Summary (7 to 36 Months)

Instructions: Transfer the Section Raw Score Totals from the 7 to 36 months Caregiver Questionnaire to the corresponding Section Raw Score Total box for the appropriate ages. Plot these totals by marking an X in the appropriate classification column (Typical Performance, Probable Difference, Definite Difference)*.

Sensory Processing Section	Section Raw Score Total	Less Than Others ← Definite Difference	Less Than Others ← Probable Difference	Typical Performance	→ More Than Others Probable Difference	→ More Than Others Definite Difference
A. General Processing	No section raw score total is calculated for the General Processing Section.					
B. Auditory Processing (7–36 months)	/50	50 -------- 48	47 ---------- 44	43 ---------- 35	34 ---------- 31	30 ---------- 10
C. Visual Processing (7–36 months)	/35	35-------- 32	31 ---------- 28	27 ---------- 20	19 ---------- 16	15 ---------- 7
D. Tactile Processing (7–24 months)	/75	75 -------- 68	67 ---------- 62	61 ---------- 48	47 ---------- 42	41 ---------- 15
D. Tactile Processing (25–36 months)	/75	75-------- 72	71 ---------- 65	64 ---------- 51	50 ---------- 44	43 ---------- 15
E. Vestibular Processing (7–36 months)	/30	30-------- 27	26 ---------- 24	23 ---------- 18	17 ---------- 15	14 ---------- 6
F. Oral Sensory Processing (7–12 months)	/35	35-------- 33	32 ---------- 30	29 ---------- 21	20 ---------- 17	16 ---------- 7
F. Oral Sensory Processing (13–18 months)	/35	**	35 ---------- 32	31 ---------- 23	22 ---------- 19	18 ---------- 7
F. Oral Sensory Processing (19–24 months)	/35	**	35 ---------- 33	32 ---------- 24	23 ---------- 20	19 ---------- 7
F. Oral Sensory Processing (25–30 months)	/35	**	35 ---------- 33	32 ---------- 25	24 ---------- 22	21 ---------- 7
F. Oral Sensory Processing (31–36 months)	/35	**	35 ---------- 34	33 ---------- 25	24 ---------- 21	20 ---------- 7

*Classifications are based on the performance of children without disabilities ($n = 489$)
**There can be no Definite Difference for this section in this age range.

Note: Reproducible Growth Curves for Children 7 to 36 months, for Sensation Seeking, Tactile Processing, and Oral Sensory Processing, are available in Appendix A of the *Infant/Toddler Sensory Profile User's Manual.*

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UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Tudor

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M081122**
PROJECT	The Sensory Profiles of Infants who Received Different Methods of Premature Neonatal Care
INVESTIGATORS	Mrs SB Tudor
DEPARTMENT	Occupational Therapy Dept
DATE CONSIDERED	08.11.28
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 09.01.21 **CHAIRPERSON** ....
(Professor P E Cleaton Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Dr S Norris

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

Occupational Therapy

School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

To: The Head of Research and Neonatology
CH Baragwanath Hospital

26 November 2009

I would like to thank CH Baragwanath Hospital and the Neonatology department for accommodating my research within your Neonatal and Kangaroo mother care Follow-Up Clinics this year, for the fulfilment of my M Sc (OT) degree requirements.

I found the staff at both clinics very accommodating and helpful, even though the research inconvenienced the running of these clinics at times. Please would you be so kind as to notify your staff of my thanks.

I look forward to sharing the results of my study with you on completion of this thesis in 2010. The research investigates the effects of premature neonatal care on the sensory processing abilities of infants. I will be presenting my results to the Occupational Therapy department at your hospital during the course of 2010. Your department will be notified when this is to take place should you wish to attend the presentation.

Please feel free to contact me with any queries regarding results obtained.

Thank you,

Shirley Tudor

THERAPEUTIC Sciences

Table 1 Sensory Profile – Summary of sensory processing sections

	Subject No	Auditory	Visual	Tactile	Vestibular	Oral Sensory
KMC	1	32	27	39	22	17
	3	25	19	39	17	23
	5	43	22	48	20	26
	6	32	21	44	15	23
	7	33	23	38	11	24
	8	38	22	48	20	22
	9	38	19	41	17	17
	12	33	15	51	21	29
	13	37	20	33	16	20
	14	38	19	43	22	27
	15	36	19	51	20	24
	16	30	19	40	15	23
	18	40	24	36	26	23
	19	44	19	50	20	24
	20	30	21	39	18	16
	21	36	19	42	18	25
	22	41	19	52	18	22
	23	20	12	32	14	14
	24	34	23	51	18	23
	25	50	15	41	9	14
	26	31	17	36	22	22
	27	27	18	48	15	18
	28	38	20	47	16	26
	29	31	15	38	21	24
	30	32	19	42	18	22
	31	38	18	35	18	23
	32	33	19	38	18	17
	33	28	16	40	19	22
	34	31	20	44	19	23
	35	35	19	42	17	20
	36	32	26	36	20	20
	40	39	19	54	19	32
	43	39	19	49	16	25
	48	36	27	40	13	18
CC	2	34	26	53	16	22
	4	29	18	43	16	23
	10	30	14	57	21	25
	11	30	14	57	21	25
	17	34	23	50	24	26
	37	39	21	50	20	25
	38	39	23	49	16	20
	39	39	21	47	19	25
	41	32	14	32	14	18
	42	15	8	36	10	7
	44	33	19	49	18	24
	45	33	19	49	18	24
	46	38	16	34	20	18
	47	42	22	53	30	28
Mean		34.3125	19.3125	43.875	18.1458333	22.04166667
SD		5.993458	3.7877532	6.8311707	3.75861894	4.34647489
Key		Total /50	Total /35	Total /75	Total /30	Total /35

Table 2 Sensory Profile – Summary of quadrants

	Subject No	Quad 1	2	3	4	Low thresh	Relevant
KMC	1	41	35	26	37	63	*
	3	37	23	30	36	66	*
	5	48	32	41	53	94	
	6	43	28	36	42	78	
	7	41	27	28	43	71	
	8	42	40	33	48	81	
	9	37	34	36	39	75	*
	12	43	42	36	38	74	*
	13	53	16	29	41	70	*
	14	55	18	35	56	91	
	15	53	20	38	50	88	
	16	37	27	37	36	73	*
	18	47	39	33	45	78	
	19	48	27	45	48	93	
	20	36	18	38	47	85	
	21	55	20	33	45	78	
	22	54	21	42	50	92	
	23	23	27	21	25	46	*
	24	41	28	49	46	95	
	25	37	25	40	42	82	
	26	37	27	33	43	76	*
	27	44	22	36	32	68	*
	28	49	19	44	49	93	
	29	40	27	34	39	73	*
	30	49	15	37	42	79	*
	31	43	26	36	40	76	*
	32	40	30	33	35	68	*
	33	26	44	25	43	68	*
	34	33	47	35	33	68	*
	35	50	19	37	35	72	*
	36	40	31	32	41	73	*
	40	44	39	43	47	90	
	43	49	24	36	54	90	
	48	51	26	29	39	68	*
CC	2	50	26	44	45	89	
	4	42	30	32	38	70	*
	10	37	39	38	40	78	*
	11	37	39	38	40	78	*
	17	40	36	39	49	88	
	37	52	24	45	47	92	
	38	45	30	40	45	85	
	39	49	30	37	48	85	
	41	41	16	21	38	59	*
	42	18	18	25	20	45	*
	44	40	28	37	48	85	
	45	40	28	37	48	85	
	46	50	17	31	41	72	*
	47	48	41	47	54	101	
Mean		42.8125	28.02083	35.5625	42.5		
SD		7.891973	8.169715	6.259992	7.0981		
Key		Total /55	Total /70	Total /55	Total /60	Total /115	

Table 3 Fisher's exact values for the comparison of both groups' responses for all 48 items of the Sensory Profile

Question	Fisher's exact value	Question	Fisher's exact value
1	0.26	**25**	0.17
2	0.82	**26**	0.15
3	0.26	**27**	0.66
4	0.30	**28**	0.91
5	0.61	**29**	0.52
6	0.94	**30**	0.04*
7	0.92	**31**	0.74
8	0.28	**32**	0.60
9	0.37	**33**	0.67
10	0.32	**34**	0.31
11	0.90	**35**	0.32
12	0.07	**36**	0.18
13	0.96	**37**	0.78
14	1.00	**38**	0.92
15	0.68	**39**	0.76
16	0.09	**40**	0.94
17	0.08	**41**	0.55
18	0.52	**42**	0.13
19	0.09	**43**	0.14
20	0.26	**44**	0.49
21	0.14	**45**	0.25
22	0.08	**46**	0.45
23	0.80	**47**	0.40
24	0.25	**48**	0.93

*Significance p≤ 0.05

Table 4 Marital status and number of children born to caregivers that participated in this study

	KMC group n = 34 infants	CC group n = 14 infants	p value
Number of children			0.04*
1	44.12%	14.29%	
2	32.35%	35.71%	
3	11.76%	21.43%	
4	11.76%	28.57%	
5+	0%	0%	
Marital status			0.55
Married	26.47%	35.71%	
Single	73.53%	64.29%	
Divorced	0%	0%	
Widowed	0%	0%	

*Significance p≤ 0.05

Table 5 Weeks gestation and birth order of the infants that participated in this study and the number of children living in the home

	KMC group n = 34 infants	CC group n = 14 infants	p value
Average gestation	31.32 weeks	30.86 weeks	0.63
Weeks gestation			
26-27	5.88%	14.29%	
28-29	23.53%	7.14%	
30-31	20.59%	28.57%	
32-33	26.47%	35.71%	
34-35	8.82%	7.14%	
36-37	14.71%	7.14%	
Birth order			0.11
1st	50%	14.29%	
2nd	26.47%	42.86%	
3rd	11.76%	42.86%	
4th	11.76%	0%	
5th	0%	0%	
More than 3 children living in the house			0.17
Yes	14.71%	35.71%	
No	85.29%	64.26%	

*Significance p≤ 0.05

Table 6 Average length of stay, birth weight and discharge weight for the infants that participated in this study

	KMC group n = 34 infants	CC group n = 14 infants	p value
Average length of hospital stay	31 days	31.15 days	0.98
Average birth weight	1307.94g	1435.36g	0.09
Average discharge weight	1667.59g (Data unavailable: 5)	1686.07g (Data unavailable: 1)	0.75

Significance p≤ 0.05